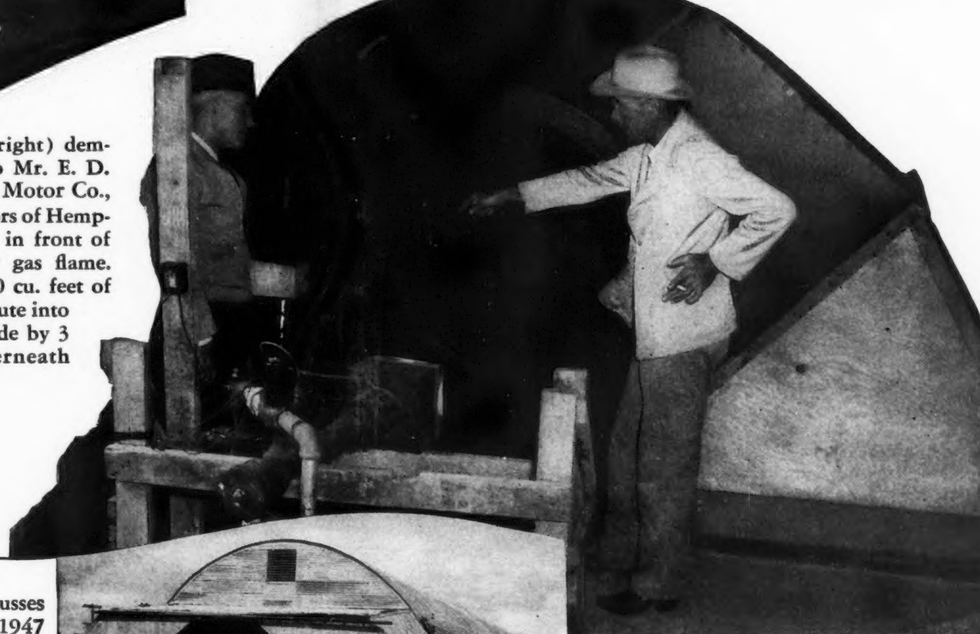
AGRICULTURAL ENGINEERING

FEBRUARY · 1947

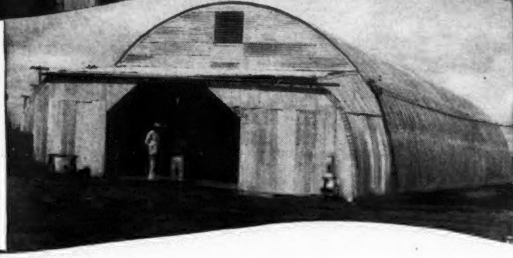
ASAE

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

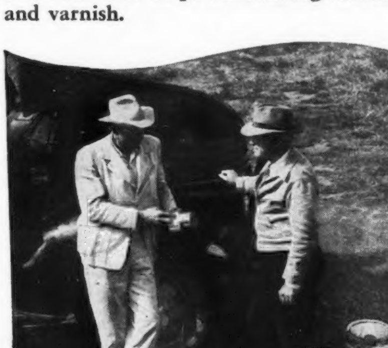
This NOVEL DRYER developed by Texas Agricultural Engineers PROVES A PROFITABLE CROP SAVER



Mr. A. L. Carter (right) demonstrates dryer to Mr. E. D. Sorsby of Sorsby Motor Co., Texaco Distributors of Hempstead, Texas. Air in front of fan is heated by gas flame. Fan drives 42,000 cu. feet of warm air per minute into tunnels 6 feet wide by 3 feet deep, underneath drying bins.



Mr. Carter discusses prospects for 1947 with his manager, Mr. Morris M. Davis. Photo shows size of dryer.



Mr. Carter finds that New and Improved Havoline Motor Oil keeps his engines clean and free of power-robbing carbon and varnish.

Mr. A. L. Carter, a progressive farmer of Hempstead, Texas, called in the Agricultural Engineers of A. and M. College of Texas to help him develop the dryer shown above. Mr. Carter has 795 acres of peanuts.

"We had been losing a lot of peanuts each year because they were damp and so unmarketable," explained Mr. Carter. "This dryer is the greatest advance in the peanut industry. It prevents big crop losses."

Mr. Carter dried 380,000 pounds of peanuts last year and, in addition, more than 2,000,000 pounds of his neighbors' crops.

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RAYMOND OLNEY
Editor and Business Manager

EDITORIAL

Strengthening Our Foundations

ONLY yesterday in this age called civilization our Colonial fathers said "We hold these truths to be self-evident . . . ."

For the first time in recorded history these "self-evident" truths gained enough support for a thorough field test as the foundation of a new and better economy. Thus was eased the way for the freedom of thought and action by which men might learn other truths, less self-evident, but of tremendous potential usefulness to man.

Limitations of the human mind are such, however, that we still struggle along with only partial recognition and acceptance of these self-evident basic truths and many others not quite so evident; and with continued acceptance as fact of much that is false. We are building on a minimum-strength foundation of accepted truth.

Challenging these frailties and fallacies of the public mind is an extracurricular activity of Fred A. Wirt, active member and past-president of A.S.A.E. For some years, as circumstances have permitted, he has addressed such organizations as the National Farm Chemurgic Council, Rotary and Kiwanis Clubs, and "city farmer" clubs on the subject of "Food, Farm Machinery, and Freedom."

Though he speaks mainly in terms of a single division of agricultural engineering, the points he makes by a wealth of historical citations apply with equal force to the entire profession and all its varied activities. He makes it clear that continued and increased opportunity for agricultural engineers to work effectively in the interest of agriculture, and of the hungry mouths it feeds, depends on general recognition and acceptance, not only of self-evident truths, but of some which may seem obscure. Otherwise obstacles will be placed in our path, inadvertently or purposely, by business, labor, agriculture, government, and direct-actionists, in matters of finance, supply, production, education, application, and legislation.

Fortunately the foundation for understanding of our economy can be strengthened by talking to people in terms of their own self-interest; specifically, by picturing the conditions under which they would have to live in economic systems based on other ideas.

From one of Mr. Wirt's addresses we summarize the following points on which wide understanding is particularly important to agricultural engineers, agriculture, and the general public:

1 High productivity in agriculture as the primary basis of material and humanitarian progress

2 Freedom of thought and enterprise as a condition prerequisite to progress in engineering and high productivity

3 Flexibility in the amount of work to be done, as influenced by the ability of people to develop new objectives after the means of self preservation are assured

4 Wealth as a revolving fund consisting primarily of consumer goods and physical means of producing them, to be used as an incentive and means of increasing productivity and to be continually renewed by high productivity to rise above the subsistence level of existence

5 Agriculture as the work of an important minority, the source of self-preservation beyond which develops the opportunity to pursue other objectives

6 Dependence on public opinion for maintaining the unique combination of conditions which spells opportunity

We scarcely need to sell ourselves on the inherent truths in these matters. We do need to remind ourselves periodically that their appreciation by others influences greatly our opportunity to work as agricultural engineers; that the alternative is retrogression toward a crooked-stick agriculture by which perhaps half of our present population might scratch out a short, precarious existence.

Hence we have need to follow the example set by Mr. Wirt in bringing these truths to public attention. It is more than a one-man job. We can't all travel the country making speeches, but we all have numerous contacts with plain, honest citizens. And many of them, in these days of uncertainty and turmoil, are particularly receptive to a few simple guiding principles.

Among these, perhaps most vital is the lesson of history that liberty is paramount, that individual freedom of initiative, incentive, opportunity, and reward are *sine qua non* for security from hunger as well as for national progress and culture.

The World in Which We Work

FROM the viewpoint of a German inventor, within the past two decades, ordinary plows have one seriously objectionable feature. They pull so hard, even for a strong man, that one or more draft animals usually have to be used for motive power!

To correct this deficiency he originated, and in 1933 obtained a U. S. patent (No. 1,934,321) on a design which he claimed "makes it so simple and easy to operate that it can be worked, without special stress, even by persons of inferior physique." In this he referred, not to the operator at the guiding end, but to the man, woman, or child out in front with a choice between such minor miseries as a "beam handle", an easily attached "haulage strap", or the sterner discipline of hunger or an angry master.

While this contribution to the art has not achieved wide popularity in the United States for apparently good reasons, it provides food for thought as to the current state of civilization and engineering progress.

We live in a world in which many people of many countries have yet to adopt and use more efficient hand or human power tools, as a step toward the accumulation of enough physical capital to command the services of more efficient animal or mechanical power.

We live in a world in which the ravages of war periodically force large numbers of people back to the human muscle power age of subsistence until their animal and mechanical power supply can be replenished.

We live in a world in which many people still fail to distinguish between muscle power as an expensive substitute for mechanical power, and craftsmanship, the creative use of the hands as tools of the mind.

We work in an economy, even in the United States, which still places much reliance on hand power. Much of the demand is for equipment of a character still colored by the "blood, sweat, and tears" hangover from days of little mechanical power or means of applying it.

We are practicing engineering in an era when efficient use of power is critical, not only as a refinement increasing the net value of mechanical power, but because so much of the world's work is still done by expensive animal power, and the still more expensive human muscle power. The inventor mentioned above had a sound objective. Agricultural engineering to carry the efficiency and security of food supply beyond the man-power plowing stage is basic to increasing appreciation and realization of the values of human life.

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Precision Planting Equipment

By Roy Bainer
FELLOW A.S.A.E.

THE introduction of processed sugar beet seed in 1942[1] and its subsequent widespread adoption created a demand from growers for improved planting equipment. Previously, when the natural multigerm seed was drilled at rates varying from 15 to 20 lb per acre, little consideration was given to planters. The practice at that time was to have a continuous row of seedlings from which a final stand of approximately one beet per foot was obtained by short-handled hoe blocking and finger thinning, an operation requiring 20 to 30 man-hours per acre. Planters employing the internal-run, fluted-feed, or large-cell plate principle in conjunction with a spiral ribbon tube gave satisfactory results for whole seed. They failed, however, to give the uniform distribution desired when processed seed, containing a high percentage of single-germ units, was planted at six to twelve seed units per foot (3 to 6 lb per acre). Growers recognized that the use of processed seed in planters capable of uniform metering and placement would save considerable labor in the thinning operation. Furthermore, improved stands offered the possibility of substituting mechanical blocking and thinning for the hand operation. Modifications of the fluted and internal-run feeds, made during the war when the manufacture of new machinery was limited, improved their performance but still did not give the desired uniformity of the seedling stand.

Preliminary to starting the planter testing and development program, laboratory apparatus was set up at the California Agricultural Experiment Station for testing the units before making field trials with them. The apparatus (Fig. 1) consisted of a stand, adjustable in height, for mounting the units under test. A suitable power drive was provided for operating the units at speeds comparable with those encountered in the field. An endless conveyor was provided for carrying grease-coated boards (96 in long) under the planting device being tested, to receive and hold the seeds metered by the unit for distribution studies. The speed of the conveyor can be varied to correspond with planting speeds in the field.

A method for making a statistical analysis of the data covering the seed arrangement on the greased boards was developed by Brooks and Baker[2]. The dispersion coefficients obtained from an analysis of the data provided a mathematical comparison of the performance of different planters for similar seeding rates. This method was also useful in determining the effect of modifications in design on the performance characteristic for any unit under development. The method followed for analyzing the data is based on a "non-dimensional standard deviation". As the value of the dispersion coefficient approaches the zero, the planter performance approaches perfection.

Fig. 1 Laboratory apparatus for making greased board tests of planters

Early in the planter development program, uniform close grading of processed seed was found necessary if multiple-cell fill was to be avoided. Seed processed by segmentation gave the best results when graded to within a range of 2/64 in[3] in size. To meet this limitation in size, some sugar companies are processing and grading to a size that will pass through a 9/64-in round-hole screen and be retained on a 7/64-in round-hole screen. Seed processed by decortication or burr reduction[4] may vary as much as 3/64 in in size without causing excessive double-cell fill. Likewise, graded whole seed and pelleted seed give little trouble with multiple-cell fill when sized within a 3/64-in limit. The greater size range is permissible in these latter cases because of the more nearly spherical shape of the seed.

Planters employing either vertical, horizontal, or inclined plates are capable of uniform metering of seed. It is essential that the cells in the plates fit the seed to be planted. The diameter of the cell should be 1/64 in larger than the maximum diameter of the seed to insure proper clearance. Movement of seed through the cell is further improved by tapering the cell wall from top to bottom. Tapering to an included angle of approximately 12 deg is sufficient to insure free movement of the seed through the cell. Proper plate thickness depends upon the type of seed. For processed sugar beet seed, plate thicknesses approaching the smaller dimension of the

This paper was presented at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1946, as a contribution of the Power and Machinery Division.

ROY BAINER is agricultural engineer, University of California.

[1]Bainer, Roy. New Developments in Sugar Beet Production. AGRICULTURAL ENGINEERING, vol. 24, no. 8, pp. 255-58, August, 1943.

[2]Brooks, F. A. and Baker, G. A. Methods of Describing Regularity of Seed and Seedling Spacing. Proceedings of the American Society of Sugar Beet Technologists, 1946 (in press).

[3]Sizes of seed are expressed in 64ths because the screen sizes used for grading are expressed in that manner.

[4]Bainer, Roy and L. D. Leach. Processing Sugar Beet Seed by Decortication, Burr Reduction and Segmentation. Proceedings of the American Society of Sugar Beet Technologists, 1946 (in press).

size range of the seed are required to reduce the amount of multiple-cell fill. For example, segmented sugar beet seed graded 9-7[5] may be planted with a plate 7/64 in thick and having cells 10/64 in in diameter. On the other hand, 10-7 decorticated sugar beet seed, due to being more spherical in shape, requires a plate with 11/64-in diameter cells and a thickness of 8/64 to 9/64 in, while graded whole and pelleted seed usually require a plate thickness equal to the maximum diameter of the seed.

Three planters incorporating vertical plates were included in the studies, namely, Rassmann, Cobbley, and Milton. The Rassmann unit (Fig. 2) consists of a cast-iron housing enclosing a wheel or plate with an offset rim 0.125 in thick. One hundred twenty-eight (another model has 180 cells) equally spaced countersunk cells, 11/64 in in diameter, extend through the offset rim. The underside of the rim is backed by a cast-iron ring. As the rim passes through the hopper, which is located on top of the housing, the cells fill with seed. Upon leaving the hopper the rim passes under a cutoff into a confined area of the housing until near the lowest point of travel. Here the housing is relieved to permit the seeds to fall out, or be pushed out by a positive-action, star wheel knockout. The plate is driven through a chain stage by a small ground wheel, making each unit independently operated.

The Cobbley unit (Fig. 3) consists of a cast-iron case enclosing a bronze rotor 6 in in diameter with sixty equally spaced cells 10/64 in in diameter extending 0.103 in radially into the rim. The leading edges of the cells are relieved to facilitate filling. A machined groove extends around the rim, passing through the center of the cells. A thin tapered metal ejector operates in the groove at the point of discharge for crowding seeds out of the cells. The rotor is mounted on a horizontal shaft and is driven by a ground wheel through a chain stage. The cells fill similarly to the Rassmann unit. A fixed cutoff prevents more than one seed in a cell from leaving the hopper. Occasionally, when one small seed falls into the cell, there is room for part of another. If the second seed enters the cell far enough for its center of mass to be below the rim, the cutoff will shear it as it leaves the hopper.

[5]Indicates size of seed—grading done through 9/64-in and over 7/64-in round-hole screens.

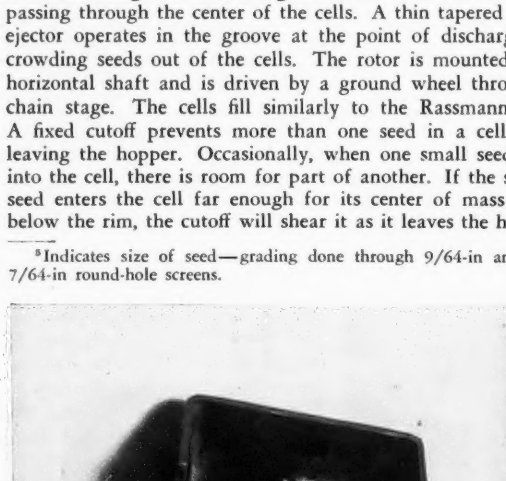
This action usually ruins that particular seed, but insures that only one good seed is carried in each cell. While this action is commendable from the standpoint of metering single seeds, it has the disadvantage of grinding a small amount of seed thereby ruining the germination of this portion. The presence of broken seed in the hopper introduces the likelihood of interference with normal seeds filling every cell, since the broken material must eventually be carried out of the hopper in the same manner as the normal seed.

The positive discharge of seeds from the rotor of the Cobbley unit, resulting from being crowded out of the cells by the properly phased ejector (Fig. 4), plays an important part in the uniform distribution of seeds from this unit. The use of a smooth metal tube (3/8 in in diameter) for receiving the seeds from the rotor and conveying them to the furrow offers a minimum of restriction to the seeds as they fall. At the same time the width of the trajectory path of the seeds leaving the rotor is narrowed to a width equal to the tube diameter.

An early model of the Cobbley planter employed the use of a 5/16-in diameter plastic tube for receiving and conveying the seed from the rotor to the furrow. Some trouble was experienced with clogging, which was apparently due to the building up of a static charge on the walls of the tube. The trouble was corrected by the substitution of metal tubing.

The Milton planter is similar in construction to the Rassmann and Cobbley units. Seed is metered by a circular plate with an offset rim 10 in in diameter and 0.125 in thick, containing 97-0.175x0.175-in notches around the periphery. A positive cutoff is used. The plate is driven through suitable gearing by the disk openers instead of by an auxiliary wheel as in the case of the Rassmann and Cobbley units. A groove machined in the underside of the offset rim, passing through the center of the cells, permits the use of a thin metal ejector for forcing seeds out of the cells, at the point of discharge. No provision is made for narrowing the width of the trajectory path at the point of discharge as the seeds fall free to the open furrow.

The horizontal-type plate planters included in the test were the John Deere and International Harvester beet and bean combinations. Horizontal plates of various thicknesses and



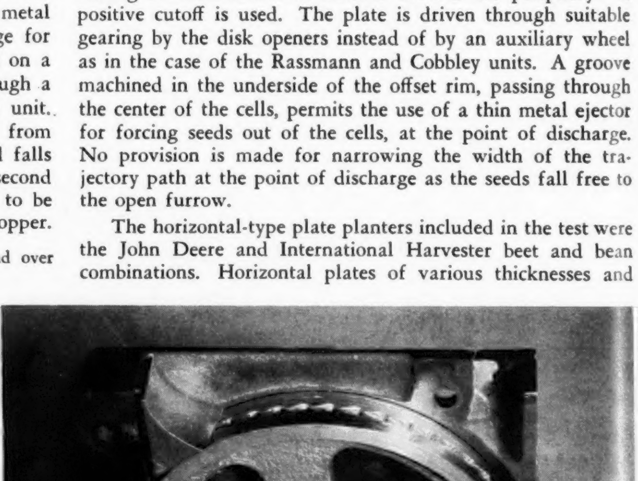


Fig. 2 *(Left)* Cutaway view of Rassmann vertical planter • Fig. 3 *(Right)* Cobbley unit opened to show seed rotor and positive cutoff

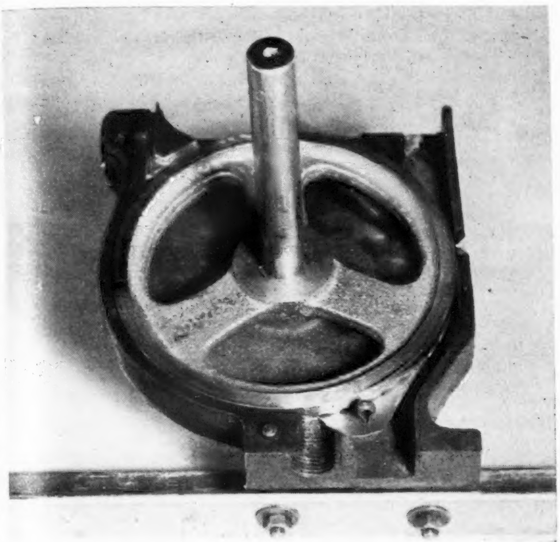


Fig. 4 A metal ejector, operating in a groove milled through the center of the cells of the Cobbley unit, crowds seeds out at the point of discharge (threaded section)

cell diameters are available to handle the various sizes of seed. Both of these units employ spring loaded cutoffs and false plates for backing up the seed plate except at the point of discharge. Extra seeds well anchored in the cell usually force the cutoff to lift permitting them to pass underneath instead of being sheared as was the case with the Cobbley and Milton units. Star-type knockouts are used in both planters. When the work with horizontal plate planters was started, the metering units were mounted on the planter frame approximately 30 in above the ground level. Spiral ribbon tubes conducted the seeds from the plate to the opener. This year, however, John Deere brought out a new machine (No. 66) in which the hoppers are mounted directly on disk furrow openers. A 14-in length of ¾-in stainless steel tubing carries the seed from the plate to within 3 in of the bottom of the furrow. The plates and false ring are machined to give a better working fit, and a final drive consisting of bevel gears and a tumbling shaft carries power directly to each planting unit.

Certain problems are common to all plate-type planters. First the seed must have sufficient opportunity to enter the cells. Exposure of the cells to the seed must be provided for. The horizontal plate usually is operated with a greater per cent of the cells exposed to the seed than in the vertical-plate type. Also, in a horizontal plate the cell walls are always vertical, while in the vertical-plate planter there is only one position of the cell when its walls are vertical. This occurs when the cell reaches the top of its travel. Plate speed affects cell fill. For example, when the Cobbley rotor was operated to give a rim speed of 33 fpm the cell fill was 101 per cent (3.07 lb per acre). The cell fill amounted to 76 per cent (4.33 lb per acre) at a rim speed of 66 fpm. A comparison of the above data indicates that a speed increase of 200 per cent resulted in only a 141 per cent increase in the seeding rate. For precision planting with present equipment, it is essential to hold field speeds to 2.5 to 3 mph when planting at rates from 3.5 to 5 lbs per acre to insure proper cell fill.

The manner in which seeds leave the plate has considerable influence upon their distribution. A seeding rate of 4.5 lb per acre at 2.5 mph requires the metering of 30 seeds per second. Therefore, a seed that is delayed only 1/30 sec is overtaken by the seed from the next cell. Positive unloading of the cell is essential to regularity of drop. The method employed for ejecting seeds from the cells of the Cobbley unit is a good example of a positive method. Seeds upon leaving the cell have a component of velocity equal to the speed of the cell. The trajectory followed by each is quite variable. This alone accounts for some of the irregularity experienced with the crop. The substitution of small smooth tubes for the large spiral ribbon tubes found on many planters confines the path of the trajectories to a space equal to the diameter of the tube. The smooth tube also offers less restriction to the seed as it falls to the furrow.

TABLE 1. GREASED BOARD TESTS COMPARING DISTRIBUTION OF SEED DROPPED FROM PLANTER THROUGH REGULAR SPIRAL RIBBON TUBE AND DISK OPENER VS. SMALL SMOOTH TUBE

(9-7 Segmented Seed Used in 72-Cell Plate; Cell Diameter, 9/64 in; Plate Thickness, 7/64 in; Seeding Rate, 3.7 lb per Acre; 32 ft of Boards)

Seeds per inch				Inch spaces without seeds									Dispersion coefficient
4	3	2	1	0	1	2	3	4	5	6	7	8	
Spiral ribbon tube, 32-in drop													
2	7	40	118	62	43	31	15	8	3	2	0	1	1.19
Telescoped small smooth tube, 32-in drop													
		14	179	56	104	34	6						0.25
Single-length small smooth tube, 15-in drop													
		19	190	54	143	11	1						0.12

Early in the study greased board tests (Table 1) were run on a horizontal plate planter, first equipped with the conventional spiral ribbon tube and disk furrow openers, then with two lengths of chrome-moly tubing, one 15 in long and ½ in in diameter, the other consisting of ½-in and ⅝-in tubes telescoped together to give a total length of 32 in. The same plate was used in all tests. The seeding rate was 3.7 lb per acre (7.1 seeds per foot), the length of run 32 ft. When equipped with the ribbon tube, bunching of seeds gave 40, 7, and 2 in with 2, 3, and 4 seeds in each, respectively, while the test with the 32-in telescoped tube gave 14 in with 2 seeds in each. The contrast is equally as great when skip distances are compared. While the test with the 32-in smooth tube gave only 6 spaces of 3 in each, the test with the spiral ribbon tube showed 15 of this size and other larger ones up to one of 8 in. Dispersion coefficients of 1.19 and 0.25 for the ribbon and smooth tube, respectively, indicate a large significant difference in distribution of seed. Tests with a single 15-in length of smooth tube were better than those using the 32-in telescoped tube. The reason for telescoping the tubes was to permit the raising and lowering of the furrow openers.

In the tests of the Cobbley unit (Table 2) the effect of narrowing the trajectory taken by the seed is shown in the first and third runs. When the seed fell free from the rotor through a distance of 1 in, the dispersion coefficient amounted to 0.24. This was reduced to 0.11 by adding a 15-in length of chrome-moly tubing ½ in in diameter. The reason for the added length was to permit mounting the metering device on top of a disk furrow opener. The improvement in performance shown for the commercial Cobbley unit (Table 2) was due primarily to the type of seed used. Decorticated seed is more uniform in size and has a smoother exterior than segmented seed. The test covering the use of a 15-in length of common iron pipe is included to show the effect of the roughness of the interior on the dispersion of seed. The value of 0.48 for the coefficient is above the good performance range.

Experience with the Milton unit has been quite limited. Greased board tests were run on a preliminary model in the laboratory. No field experience has been obtained thus far. The rotor is driven by the disks of the furrow opener through suitable gearing. Actually traction was obtained from the

depth-control bands on the side of the disks. The distribution characteristics could no doubt be improved by adding a small diameter tube at the discharge for narrowing the width of the trajectories followed by the seeds as they leave the rotor. However, the value of the coefficient was satisfactory considering the fact that the seed used varied 3/64 in in size.

Before consistent results were obtained with the International Harvester unit it was necessary to provide means for holding the false plate in a definite relation to the bottom of the can. This was done by making a slotted hole in the false plate to fit over a pin in the can bottom. The knocker wheel stop was relieved to permit further entry of wheel into the cells. Additional spring pressure was added to the cutoff to prevent lifting too freely. A short length of ½-in tubing was attached to the false plate. The short length telescoped with a 14-in length of ⅝-in tubing. Actually with the present disk opener mount it is impossible to run a straight tube from the plate to the furrow. In practice it has been necessary to provide a curved tube to get around the casting in the opener. Tests with a curved tube did not compare favorably with those for a straight tube. Redesign will permit the use of a straight tube through the furrow opener. The results shown in Table 2 are for a straight tube only.

The test on the John Deere No. 66 planter (Table 2) was made with 10-7 decorticated seed. The range in size of this sample was 1/64 in greater than the seed used in all other tests except the Milton. The dispersion coefficient of 0.17 is still in the range of precision work.

An experimental planter employing the horizontal plate principle was designed, and built by C. J. Lorenzen, Jr.,[6] while assisting with the project. All parts of the unit were machined to give close working clearance. A positive cutoff was provided. Provision was made for holding seeds in the cells until forced out by a star wheel knockout. The performance in the laboratory showed the unit to have the best seed distributing characteristics (Fig. 5) of all planters tested (dispersion coefficient, 0.009, Table 2). However, in field tests, to be reported later, it did not show sufficient improvement over some of the other units to justify continuation of its development.

Pelleting of seed to give better shape and greater uniformity in size as an aid to improved planting has attracted considerable attention recently. The last two runs (Table 2) were made with pelleted beet and tomato seed. Other small or irregular-shaped seed, such as lettuce, cabbage, carrot, onion, celery, eggplant, pepper, etc., have been successfully pelleted. Once they are in this form, they can be quite readily planted direct in the field. Two plantings of 10 acres each were made last year in the Davis, Calif. area with pelleted tomato seed, using the new John Deere No. 66 planter (Fig. 6). The distance between rows was 6 ft. One planting was made at 3 seeds per foot, the other at 6 seeds per foot. The plantings were thinned to give a final stand of approximately 50 plants per 100 ft of row. Each planting gave a satisfactory final stand. As a result of these two tests, several hundred acres of tomatoes will be seeded directly in the field in this area next season.

TABLE 2. GREASED BOARD TEST OF PLANTERS

Sample Data Showing Seeds per Inch, Inches Without Seeds, and Dispersion Coefficient (32 ft of Boards per Run; Board Speed, 2½ mph)

	Seeds per inch			Inch spaces without seeds							Dispersion coefficient
	3	2	1	0	1	2	3	4	5	6	
Modified Cobbley vertical-plate planter: 50-cell rotor; 9-7 segmented seed; 1 in free fall	1	5	188	51	109	31	5	1			0.24
Same as above except through 15-in length of ½-in pipe		37	148	56	81	33	12	4			0.48
Same as above except through 15-in length of ½-in smooth tube		9	205	58	140	12	2				0.11
Commercial Cobbley vertical-plate planter: 60-cell rotor; 9-7 decorticated seed; dropped through 5-in length of ⅜-in smooth tube		2	157	14	75	65	6		1		0.05
Modified Rassmann vertical-plate planter: 185-cell rotor; 10-8 segmented seed; 1 in free fall		8	160	17	93	50	7	1			0.19
Milton vertical-plate planter: 99-cell rotor; 10-7 decorticated seed; 2 in free fall		1	129	17	33	46	20	11	3	1	0.24
Modified International Harvester No. 40 horizontal-plate planter: 80-cell plate; 9-7 decorticated seed through 15-in length of ½-in smooth tube			143	9	47	76	7	5			0.10
Modified John Deere No. 55 horizontal-plate planter: 72-cell plate; 9-7 decorticated seed through 14-in length of ½-in smooth tube		2	133	2	38	77	16	1	1		0.10
Commercial John Deere No. 66 horizontal-plate planter: 72-cell plate; 10-7 decorticated seed through 14-in length of ¾-in stainless steel tube		4	133	11	38	55	24	5	1		0.17
Experimental horizontal-plate planter: 72-cell plate; 10-8 segmented seed through 15-in length of ½-in smooth tube		1	208	40	168	2					0.009
Modified John Deere. No. 55 horizontal-plate planter: 72-cell plate; 12-9 pelleted beet seed through 15-in length of ½-in smooth tube		1	135	1	48	68	16	3			0.08
Commercial John Deere No. 66 horizonal-plate planter: 72-cell plate; 11-9 pelleted tomato seed through 14-in length of ¾-in stainless steel tube		2	137	7	43	79	13	3			0.10

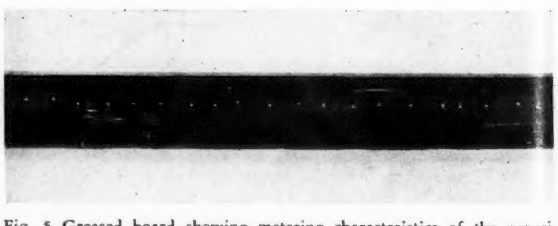


Fig. 5 Greased board showing metering characteristics of the experimental planter. Segmented seed graded 10-8 dropped through a 15-in length of ½-in chrome-moly tubing

[6]Assistant agricultural engineer, University of California.

Fig. 6 John Deere No. 66 planter planting pelleted tomato seed 3 seeds per foot in rows 6 ft apart

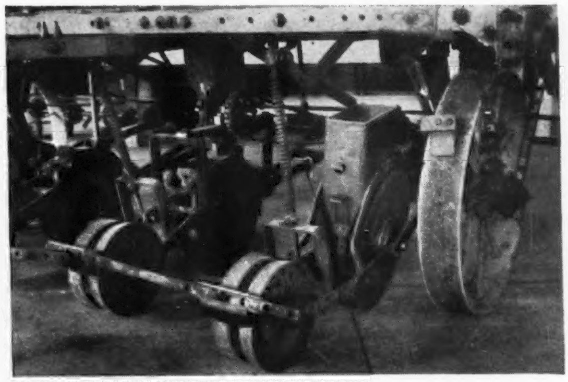


Fig. 7 Field planter equipped with various metering units. Left to right: John Deere with regular spiral ribbon tube, John Deere with small 30-in telescoped tube, Cobbley with 15-in length of ½-in tubing, and Rassmann mounted between the furrow-opener disks to place discharge point 2-in from bottom of furrow

Field trials have been made from time to time with all of the planters checked in the laboratory except the International Harvester and Milton. One series of tests, reported in Table 3, were run simultaneously with all units mounted on one frame (Fig. 7). The units consisted of a No. 32 John Deere horizontal plate planter with a standard spiral ribbon tube used in conjunction with the conventional disk opener; a No. 32 John Deere unit with a 30-in length of telescoped ½-in and ⅝-in chrome-moly tubing extending from the plate through the furrow opener to within 2 in of the furrow bottom; an experimental horizontal plate planter and a Cobbley unit, each mounted on top of the furrow openers with 15-in lengths of ½-in chrome-moly tubing extending from the metering unit to within 2 in of the bottom of the furrow; and a Rassmann unit mounted between the furrow opener disks to place the discharge point 2 in above the furrow. A 1-in length of ½-in tubing was used on the Rassmann to narrow the trajectory path followed by the seeds. Twenty-five-foot sections of the row, at random, were left unplanted by the machine. These sections were then planted by hand at 2-in intervals for comparison with the machine plantings. The segmented seed used for all the units except the Cobbley was in the size range of 10-8. The germination amounted to 92.65 per cent with 1.38 seedlings per viable seed ball. The size of the cells in the Cobbley unit required the use of 9-7 seed. The germination for this size was 83.82 and it produced 1.3 seedlings per viable unit. Two plantings were made with graded whole seed for another purpose to be discussed later.

The dispersion coefficient of 0.79 (Table 3) for the hand planting gives a value for practically perfect planting of the seed under the field conditions of this experiment. The high value, as compared to greased board tests in the laboratory, was due to spaces where the seeds did not germinate, to multiple plants from some of the seed balls, and to the fact that seedlings do not always emerge directly over the seeds. The difference in field germination between hand and machine plantings may be attributed to (1) the hand planting was made at a uniform depth, (2) the soil was probably compacted more uniformly around the seed, (3) some of the seed may have been damaged in passing through the planters, and (4) laboratory tests indicate that planter plates sometimes carry more than one seed per cell while other cells fail to fill.

A comparison of the various planter performances shows a higher coefficient value for the planter with the spiral ribbon tube than for any of the other units. The coefficients, Table 3, for the John Deere with the smooth tube, the experimental planter with a smooth tube, and the Rassmann with a smooth tube, were about the same even though the height of the units above the furrow was 32, 15, and 2 in, respectively. The coefficient for the Cobbley is lower than the others which indicates better performance. The Cobbley unit had a slight advantage because the seed used contained less germs per unit. On the other hand, it was at a decided disadvantage due to the lower germination value for the seed.

TABLE 3. FIELD TRIALS WITH EXPERIMENTAL PLANTERS

Planter	Rate, lb per acre	Seed space, in	Seed size (sheared)	Greenhouse germination Per cent	Greenhouse germination Seedlings per unit	In/100 in with beets	Total beets /100 in	Per cent inches with singles	Per cent field germ.	Dispersion coef.
Hand	3.68	2.0	10-8	92.65	1.38	39.0	49.3	73.5	77.2	0.79
Deere standard	3.06	2.4	10-8	92.65	1.38	21.0	28.8	68.2	54.1	2.23
Deere small-tube	3.39	2.17	10-8	92.65	1.38	24.5	31.8	70.1	53.9	1.35
Experimental	3.66	2.01	10-8	92.65	1.38	26.0	31.6	78.0	49.7	1.22
Rassmann	3.25	2.28	10-8	92.65	1.38	25.0	30.3	79.3	54.0	1.25
Cobbley	3.55	1.81	9-7	83.82	1.30	24.8	29.0	83.2	48.3	0.95
			Seed size (whole)							
Deere small-tube	4.6	2.34	12-10	96.08	1.84	33.2	53.2	45.7	70.4	1.81
Deere small-tube	5.95	4.28	17-15	100.00	2.87	28.2	56.3	34.3	84.0	2.87
Same as above, except calculations on basis of seed placement only multiples disregarded										0.10

Large whole seed (graded 17-15) having an average seedling count of 2.87 per viable unit and a greenhouse germination of 100 per cent was used in the planter trials primarily to check the uniformity of seed placement in the furrow. A John Deere unit equipped with a single seed ball plate of the notched type was used. The seed was dropped through 30 in of tubing. The gear ratio was set to give a theoretical spacing of 4.28 in between seeds. This assured complete separation of the plants from each seed ball. The seed had a horizontal velocity of 220 fpm as it left the tube. It was thought that this horizontal component of velocity might cause the seed to roll slightly as it hit the ground, the extent of which would be influenced by the roughness of the furrow bottom.

Data on this planting was taken in two ways. First, to show the location of each seedling in the normal manner. From this a dispersion factor of 2.87 was calculated. The high value was due to multiplicity of seedlings from each seed ball (some produced 5 each). Second, data was taken of dispersion by considering each clump of plants as single units, much the same as individual seeds are handled on the greased boards in the laboratory. From the data taken in this manner, a coefficient of 0.10 was obtained which indicates that the seeds reached the furrow well distributed and remained close to where they landed.

The planting of whole seed, graded 10-8, was put in primarily to determine the extent that multiplicity of germs in the seed balls affected the per cent of inches of the seedling stand containing singles. Seed that contained 1.84 seedlings per viable seed ball, when uniformly spaced in the row, showed that 45.7 per cent of the inches with beets contained single plants. This indicates that all multiple-germ seed balls do not produce multiple plants in the field. Actually the arrangement of plants (dispersion coefficient of 1.81) in this trial were more uniform than the plants from the segmented seed dropped through the spiral ribbon tube (dispersion coefficient of 2.23).

Improved planting technique has pointed out the desirability of processing seed in a manner to give a greater factor of safety. By this is meant leaving more germs per viable seed unit than was originally thought desirable for the segmented seed. With this in mind, a decortication process has been developed. This new process is less drastic than segmentation on the seed. The final product from the decortication process contains approximately half single-germ units and half two-germ units, as compared to 85 per cent singles and 15 per cent doubles for the best jobs of segmenting. The decorticated seed, in addition to giving improved germination, is uniform in size and has a smoother exterior, with the result that it can be planted with greater regularity than segmented seed. Results obtained so far indicate that 100 units of decorticated seed will produce as many or more inches with single plants than 100 units of segmented seed when both are planted with the best equipment available today. As the per cent of field germination drops, the differences become greater in favor of decorticated seed.

Several planting units are capable of precision metering of properly graded seed. However, the principal problem yet to be solved deals with proper placement of seed in the ground to insure maximum field germination. The relatively poor field germination for machine-planted segmented seed (Table 3) indicates a necessity for improvement of furrow opening and covering devices. Precision planting requires precision seed and precision farming practices if the greatest gains are to be realized. Planters available today are capable of better performance than the seed and farming practices used justify. New developments in seed processing indicate the possibility of producing seed with a higher germination, a greater factor of safety and improved shape for use in a precision planting program. Weather hazards will continue to be one of the controlling factors in obtaining satisfactory stands even though the best available planting equipment and seed is used. In areas where plantings can be irrigated to insure germination, part of the hazards are removed.

An attempt to control some of the variables relative to obtaining a satisfactory stand of sugar beets was demonstrated in a commercial planting of 80 acres near Davis, Calif., during the past season. Decorticated seed (10-7) having a laboratory germination of 95.6 per cent with 1.75 seedlings per viable seed unit was used at the rate of 3.03 lb per acre (3.82 seeds per foot). Planting was done on beds to a depth of 1½ in with a John Deere No. 66, smooth-tube planter operating at 3 mph. The field was irrigated following planting to insure germination. Under the controlled conditions of this trial the field emergence amounted to only 49.6 per cent of the potential seedlings in the seed planted. Actually more than 49.6 per cent of the seed units produced one or more seedlings, because the counts indicate that some of the two-germ seed units produced only one plant. Stand counts showed 17.85 uniformly spaced inches per 100 in with a total of 24.75 plants. Of the 17.85 in with plants 64 per cent contained singles. Under the field germination (49.6 per cent) of this trial, seed showing approximately 25 per cent singles in the laboratory produced a stand in which 64 per cent of the inches with plants contained singles. Thinning of the field was combined with the first hoeing for weeds. The uniformity of the seedling stand was emphasized by the fact that an average final stand of 119 beets (85 per cent singles) per 100 ft of row was obtained. The final yield amounted to slightly less than 20 tons per acre.

Cobbley planters were used to plant approximately 8,000 acres of beets in the Imperial Valley (California) during the past fall. The plantings were made on single-row beds spaced 34 in apart. Segmented seed (9-7) was used at rates varying from 2½ to 4 lb per acre. Depth of planting varied from ½ to ¾ in. All plantings were irrigated to insure germination. Under the controlled conditions of these plantings, the field emergence varied from 55 to 65 per cent. Thinning was done by hand, at the rate of 10 man-hours per acre.

The author is grateful to all who have aided in carrying on the planter development program, especially to C. J. Lorenzen, H. D. Lewis, F. A. Brooks, G. A. Baker, P. E. Symens, and Fred Lory. The following firms were helpful in supplying equipment: Deere & Co., International Harvester Co., Lindeman Power Equipment Co., Diamond Iron Works, and Paul Milton. The project has been partially supported by grants from the U. S. Beet Sugar Association.

Precision Planting

By Arthur J. Bjerkan

IN August, 1942, I heard Mr. Bainer present a paper on the shearing of sugar beet seed. As I recall, the very first plantings of sheared or segmented seed in this country had been made the previous year and the results of a considerable test program in 1942 were reported by Mr. Bainer. A few weeks later I entered the Army. After three and a half years, when I again came in contact with the American sugar beet industry, I was a little surprised to find that this past year practically the entire American acreage of sugar beets was being planted to segmented seed. The reason for the change in planting practice is that the use of segmented seed has, on the average, reduced the thinning labor about one-fourth. To achieve the greatest economy in thinning labor it is necessary to have a thin and uniformly distributed stand of seedlings of which a high percentage are single plants. This requirement has focussed a great deal of attention upon sugar beet planting equipment. It seems that the term "precision planting" has come into wide use in the sugar beet industry to designate a quality of work that will permit thinning with a long-handle hoe or other economical method.

At the John Deere Wagon Works we feel we have been fortunate during these difficult years in being able to supply plates and other parts for any of our plate-feed planters which adapt them to the planting of segmented seed.

About two years ago, after a considerable testing program, design was started on a planter *(Continued on page 57)*

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Some Experiences with Beet Drills

By R. L. Partridge

ANYBODY at all familiar with the beet sugar industry realizes the necessity for mechanization of thinning and harvesting the sugar beet crop. Shortage of labor and inefficient labor is forcing the mechanization if the industry is to survive. Rapid progress has been made during the last three years in the solution of this problem, especially in the development of beet harvesters. Equally rapid progress has been made in the metering devices in beet drills, but unfortunately many problems are not yet solved in the mechanization of thinning.

To Roy Bainer, whose paper appears elsewhere in this issue, must be given most of the credit in making mechanization of thinning possible, with the introduction of segmented seed and work on the development of a beet drill that will give a satisfactory distribution of the seed in the row. Further development along this line may be expected with the possibility of a single-germ seed in the future.

During the war, with shortage of labor and curtailment of the manufacture of farm machinery, it was realized that in order to take advantage of the labor saving possible with segmented seed every effort must be made to use existing drills. Changes and modifications were made on most of the drills. On the fluted and internal-run feeds the modifications, while improving their performance, did not give a satisfactory distribution of the seed. Changes made on plate-feed drills with the introduction of segmented seed at first consisted mainly in changing of the plate as to thickness, diameter of the holes, tapering of the holes, etc. Results obtained, while far from giving the results desired, indicated that these drills with considerable modifications could be used with fairly satisfactory results. Since that time, when segmented seed was first introduced, intensive study and experimental work has been done and at the present time several drills are on the market in very limited quantity that will give a satisfactory metering of the seed.

Last spring, following out results obtained in the experimental work, an effort was made in the territory in which our company operates to get adaptable plate drills modified by replacing the large spiral tube with a small smooth tube. As Mr. Bainer points out, these tubes were of metal in order to avoid the danger of a static charge in a plastic tube. Most of the John Deere plate drill models, Nos. 11, 18, 22, 32, and 55, and the International No. 40 were modified in this way.

Due to the difficulty of changing the cans from their present location to a position directly on the disk furrow openers, it was decided to use a long smooth tube leaving the hoppers in their present position. It was found that in the John Deere drills, in order to allow the disk furrow openers to be raised at the end of the row, it was necessary for the tube to discharge the seed about the level of the hub of the disk. This interfered with the proper placement of the seed in the row. With the International No. 40 it was necessary to use a curved tube to get around the casting in the furrow opener.

Conversion bundles for each drill were made at Johnstown, Colo., and shipped to the various factory districts and installed on drill by the company at cost of labor and material. Cost to grower varied from $15.00 to $25.00 per drill depending on the drill converted. The growers were very much interested in this conversion, and while exact figures are not available, from 60 to 75 per cent of adaptable drills were converted.

Results obtained in the field, while not entirely satisfactory, indicated a better distribution of the seed than was obtained from the unmodified drills. An effort will be made this winter to modify all John Deere and International plate drills not modified last spring.

At each factory district one John Deere No. 55 was modified by placing the hoppers directly on the disk furrow openers, using a small smooth tube. This drill is similar to the John Deere No. 66. While better results were obtained with this modification, it is costly to make and the majority of the growers would rather wait for a new drill than spend too much money remodeling their old ones.

As brought out by Mr. Bainer, there are now several drills that give a satisfactory metering of the seed. However, results obtained in actual field performance clearly indicate the need for further improvement in the proper placement of the seed in the ground and improvement in the pressing or firming of the soil around the seed. Precision metering of the seed is not sufficient. Better germination of the seed and a higher per cent emergence of the sprouts must be obtained if mechanization of the thinning is to be successful and if it is to be adopted by the grower.

Several other problems as yet not entirely solved enter into the successful mechanization of thinning. I would like to mention some of them briefly.

Seed. No matter how mechanically perfect the metering device of a drill may be, a satisfactory distribution of the seed is impossible without seed of fairly uniform size. At present some companies have met this problem by furnishing a 9-7 seed. This is seed run through a 9/64-in screen and over a 7/64-in screen, to the owners or users of precision drills. Other companies issue a 10-7 seed to all growers regardless of what drill they are using. Mr. Bainer's results indicate that a range of 2/64 to 3/64 in is permissible without causing excessive double-cell fill.

It is obvious that the nearer the approach to a one-size seed, the nearer a perfect distribution of the seed is possible. It is also obvious that the percentage of double-germ segments is greater as the size of the segment is increased. It is interesting to note the results obtained by Mr. Bainer, with the new process, using 12-10 whole seed.

In addition to using a fairly uniform size seed it is absolutely necessary that a high percentage of germination be maintained. Precision metering of the seed loses its value when a low per cent germinating seed is used.

Seedbeds. It is very apparent that more care must be given to the preparation of the seedbed than a good many farmers have given in the past. A poorly prepared loose or cloddy seedbed will not produce a proper germination of the seed, with the resultant poor stand of beets, a stand that may not be worth saving or at best does not lend itself to a complete mechanization of thinning.

Weed Control. Perhaps one of the biggest problems left is weed control. No matter how good the distribution of the seed and no matter how high the quality of the seed, hand thinning will be required in a weedy field. The good farmers do a fairly good job in a normal season in controlling the weeds by early fall disking of the field, fall plowing or early spring plowing, and a reworking of the seedbed before planting. However, with a dry fall, winter, and early spring, weed seed fails to germinate before planting of the beet seed and beets and weeds germinate at the same time. Fall irrigation or early spring irrigation will help to control weeds, but in some sections, unless the grower has *(Continued on page 57)*

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Precision Planting of Beets and Corn

By C. E. Guelle
MEMBER A.S.A.E.

TWO crops in connection with which precision planting has received a tremendous amount of attention in the past few years are beets and corn. Factors that have stimulated this renewed attention are well known, and they have been basically the same for all crops — the need for much larger yields, a desperate shortage of labor, and the resultant demand for high-speed tractor operation.

Though the fundamental needs have been similar, the specific meaning of precision has necessarily been quite different because each crop has had a history and development of its own. The beet grower, who is concerned with seed cost and the elimination of stoop labor required for thinning the crop, thinks of precision planting in terms of accurate in-the-row placement. The corn grower, on the other hand, has as his chief concern precision planting for weed control and maximum yields. Because of this difference in the meaning of precision planting, let us consider this subject separately for each of these two vital crops.

Beets. Precision planting of beets has advanced a long way indeed since the days when this crop was planted with machines of the grain-drill type. During this period of development we have seen the introduction of segmented seed, largely through the efforts of Roy Bainer, and an almost complete change-over to individual seed cells in a rotating-plate type of design. In an effort to facilitate mechanical thinning and also to reduce seed costs, planting rates have been reduced from as much as 20 lb of whole burr seed per acre to less than 2 lb of segmented seed.

Beet planters operating at present-day tractor speeds distribute seed at rates averaging about 35 seed particles per second. The seed particles distributed at this tremendous rate vary widely as to shape and as much as 20 per cent in size. To accomplish an accurate metering of seed under such varying conditions it was necessary to eliminate variations in the planting mechanism. This required drilling and countersinking of the cells in the seed plates and machine finishing these plates and other conjunctive parts to close tolerances.

Flexible tubing such as is used on current planters has been well liked for many years because it provided a simple, trouble-free means of delivery from a hopper rigidly mounted on a stable main frame to a ground unit flexibly mounted for following the contour of the ground. For some time our company has been investigating the feasibility of going to a smooth-walled construction, utilizing seamless tubing. Tests thus far conducted now point to the advantages of a telescoping design with an upper section of smaller diameter attached below the hopper outlet, and a larger diameter section attached to the furrow opener.

The war years have dramatically demonstrated the vital importance of fertilizer application in almost every crop. For the beet grower we anticipate an ever-widening acceptance of fertilizer application with adjustable equipment that would deposit fertilizer both to the side and below the seed such as was developed for the current planters.

As designers of implements, we feel that these developments on the current machines will provide a planting accuracy that is definitely well ahead of any progress thus far announced in the domain of seed germination and field emergence. All field tests show that there is more variation in distribution and field emergence than can possibly be attributed to the planter. The germination of beet seed in the field is an unpredictable variable and grading for size is far from perfect.

According to preliminary tests, the beet planter also promises to develop into a precision planter for vegetable seeds, and in particular for pelleted vegetable seeds. The use in the planter of precision-made seed plates and roller ground-working units of the Planet Jr. type for accurate depth control show promise of gratifying results.

Corn. To the corn grower precision planting has had a markedly different history. For many years this class of farmer has had as his main objective a steady increase in yields. First he worked for better and better varieties of open-pollinated corn, then adopted hybrid corn almost overnight, and finally, in the war years, went "all out" for fertilizer. When he asked for precision planting, it was because he wanted higher yields. That meant weed control, a more nearly perfect stand, and proper fertilizer placement.

In line with this basic thinking farmers have come to demand equipment of outstanding precision and stamina. Present-day checkrow planters operated at the higher tractor speeds must accurately accumulate and deposit two, three, or four kernels of corn per hill at rates of 120 to 130 hills per minute, or about two "buttons" a second.

To accumulate hills at such speeds has called for increased smoothness of seed-plate action and closer tolerances and more careful selection of seed plates. Interference in the passage of seed from the seed plate to the ground has had to be reduced to a minimum, and it has been necessary to consider seed ejection carefully in relation to the forward motion, or inertia of the seed, so that the crosscheck would not be affected.

It has also become increasingly important to secure properly graded seed. Considerable variation was permissible when planting was done with horses. Today the careful design and manufacture of the planters can be utterly nullified if seed is not closely sorted and graded and the seed plates carefully selected.

I believe we have now come to a stage in corn planter development where we should carefully re-examine our over-all objectives. The farmer who plants in checkrow and hill drop has always been very precise in his demands, increasingly so with the war years. If he set the planter to drop three kernels in hills 40 in apart, *that* is what he expected 95 per cent of the time. The farmer who drills his corn has been equally intolerant of variations in the spacing of the kernels in the row.

This sort of thinking suffers from an important fallacy. The corn plant growing from a single kernel does not have a fixed yield. As the plant grows it sends its roots wherever nourishment is available, often to a considerable distance. The importance of this fact is confirmed by recent studies which show that it is of no great importance whether or not *all* the hills have *exactly* the same number of kernels per hill. It does not matter if some hills are one kernel short and some have one too many, *provided* that the total number of kernels per acre is correct.

If we can think in terms of per-acre population we are in a much better position to think clearly about maximum yields. To obtain a "maximum yield" is to plant according to the fertility level of a particular field. The farmer wants to "hit it

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right" so that he does not plant too heavily, yet heavily enough to avoid second-growth ears, which may be soft. In the checkrow and hill-drop regions it has been common practice to plant 2, 3, or 4 kernels per hill. If the corn is planted in 40-in rows and at 40 in in the row, there will be 7,840, 11,760, or 15,680 kernels per acre. A figure of about 14,000—midway between the last two figures — has been reported as the optimum for average fertility and moisture. Working under such average conditions, one would seriously *underplant* with only 11,760 kernels per acre at three per hill, and seriously *overplant* with 15,680 kernels at four to the hill. The only way to obtain 14,000 plants per acre at the given checkrow spacings would be to plant at least as many "fours" as "threes".

We know that a large number of farmers who formerly planted in checkrow and hill drop have now gone over to drilling. Many of them found that the change brought a wonderful boost in yields and came to the conclusion that drilling, as such, must be a better method of planting. More often than not, however, the farmer had previously checkrowed, say, 3 kernels to the hill at 42 x 42 in spacing, and then changed to drilling at 10-in spacing in 42-in rows. Without realizing it, he had increased his population. He had set his drill to plant at 10 in instead of 14 in, which would have been the equivalent of the 42-in checkrow spacing. Instead of planting at a rate equivalent to 3 kernels per hill he was raising the rate to $4^1/_5$ kernels.

The men who have switched over to drilling may not have had to worry about weed control. But how about those who are unwilling to give up the checkrow or hill drop? Are they not entitled to a checkrow planter which has means for the precision control of the per-acre population?

I am convinced that the designing of future corn planters will have to be closely geared to this new objective of planting up to, or slightly in excess of, the fertility level of the soil. In the meantime, to head off loose thinking on the part of the consumer, I regard it as essential that the concept of per-acre population be widely publicized. The farmer has been accustomed to measuring the population in terms of "kernels per hill", and usually that was either three or four. He must be so informed that he will think in terms of kernels per acre and to check that by counting the total number of kernels in a certain number of hills as against established standards.

Further studies on seed population in relation to fertility level will undoubtedly influence future developments on fertilizer application. The percentage of farmers applying fertilizer and the quantities of fertilizer they apply have steadily risen since just before the war. From various experiment station reports it is quite apparent that there is renewed interest in methods of fertilizer placement, especially in the field of side dressing. If I can correctly gauge the trend, future fertilizer attachments will be of a type that can readily be adapted for use with both the planter and the cultivator. In connection with these developments we shall probably see further study on the placement of the seed itself. Another factor which is certain to play an important role in precision planters is hydraulic control, which will not only lift the ground-working units but also accurately gauge the depth of planting.

CONCLUSION

The development of precision planting of beets and corn has I believe, been quite substantial in the past few years. Beet seed can now be satisfactorily metered in remarkably low quantities at modern tractor speeds. Further progress through research in seed delivery and seed germination are promising indeed. The precision planting of corn, which had a somewhat earlier development, now appears to be in line for fundamental changes in both theory and practice of seed distribution and fertilizer placement.

Experiences with Beet Drills

(Continued from page 55)

an irrigation well, this is not possible. It is possible that this problem may be solved by use of chemical weed killers.

Mechanical Blocking. The seeding rate definitely enters into the problem of mechanical blocking. Germinating conditions vary each year and also vary on different farms the same year. Using a high seeding rate to try and insure a stand of beets thick enough to justify blocking is not advisable. With favorable germinating conditions the stand secured is so thick that even after blocking hand thinning is required, otherwise the population of the plants left in the row is so great that a reduced yield is the result.

Rather a seeding rate that requires fairly favorable germinating conditions to give a stand that can be blocked should be used. In most cases this seeding rate under unfavorable conditions will still produce enough plants that a long-handled hoe can be used, cutting out the weeds and at the same time removing a few beets, if necessary, with a big saving in man-hours required per acre.

In conclusion, while the proper type of drill is fundamental, proper seed and good farming practices are necessary if the mechanization of thinning is successful. I believe the foregoing problems can and will be solved and that we will see mechanization of the beet crop in both thinning and harvesting in the near future.

Precision Planting

(Continued from page 54)

which made special provision for the planting of segmented beet seed but which could also be readily used for planting beans, corn, or other crops. A few of these planters were in the field last spring and for the coming year our entire production will be of the new models. The new four-row planter is designated as the No. 64 and the six-row version as the No. 66.

In the operation of planters, we have observed at times certain irregularities in the rate of planting. These have been traceable to one or more of the following causes:

1 *Slippage of Ground-Driven Wheels.* Slippage to some degree is inevitable. More slippage will occur in rough and cloddy fields than on smooth and well-packed ground. We use an average value of 5 per cent for rubber tires and 15 per cent for steel wheels in our seed-rate calculations. There may be considerable difference between fields.

2 *Too High Planting Speed.* Increasing the plate speed always decreases the per cent of cell fill and therefore also the planting rate. If seeds are large in relation to the seed cells, one can expect greater variation in planting rates to result from change in speed.

3 *Sizing of Seed.* Where the seeds vary in size, there is a tendency to plant the smaller seeds first with the result that the planting rate tapers off as the seed hopper is being emptied. If the larger seeds are too large to enter the cells readily, the tapering off effect will be pronounced. To combat this problem we recommend: (a) That the seed be graded to a uniform size, (b) that the matching of the seed plate to the sizing of the seed be checked by a test prior to the planting season, and (c) that, if there is a portion of the seed which is too large for the plate being used, the hoppers should be emptied periodically.

At present we furnish segmented beet seed plates in two cell sizes, 11/64 and 10/64 in diameter, to match the two seed-grading standards in use today. Should the industry adopt closer grading standards we would make available suitable seed plates.

With reference to pelletized seed we are probably in about the same position as we were with segmented seed four or five years ago. What is reported by Mr. Bainer today may well be the accepted, universal practice four years from now. At least from a superficial consideration, the handling of pelleted seeds does not seem to present any problems. As with segmented beet seed we shall endeavor to follow the developments and make available equipment which will meet the needs of the grower.

Improved Duct Design for Mow Hay Finishers

By Arthur Kramer

ON THE Pacific Coast in western Washington, where air humidities are often 100 per cent from about four o'clock in the afternoon until about ten o'clock next morning, even on clear summer days, the design of mow hay finishers is indeed a problem. Accordingly we have examined critically the features of conventional installations for ways of improving air volume. With the use of simple practices in design of air ducts, as used by air-conditioning engineers, we have been able to obtain a 55 per cent increase of air volume on a test system, done by attention to elimination of air turbulence in the duct system. The testing was done on a full-size installation on a local farm. Only the ducts were redesigned. The blower unit and the plenum chamber were not disturbed.

The barn on which the tests were made was that of Roy E. Meredith of Issaquah, Wash. The tests were conducted by two young mechanical engineers, students of the University of Washington.

Type of Hay Finisher Selected. In choosing to redesign conventional ducts for improved air deliveries, we selected an existing system that was already good in performance, one that provided about 12 cu ft of air per minute per square foot of mow floor area, one that had been used several seasons, and an installation reasonably small so that changes could be made readily. The hay finisher served a floor area of 900 sq ft, and in arrangement consisted of a 5-hp electric motor driving a turbine-type blower mounted on the outside of the barn, with the plenum chamber inside against one wall and air laterals on the floor across the mow spaced on 4-ft centers.

The plenum or pressure chamber was 3 ft wide, 5 ft high and 23 ft long. The laterals were of the telescoping type in three sections each. These were supported above the floor for a 1-in air gap by means of cleats placed crosswise under each duct. It is these laterals, or air ducts, that were redesigned.

Sources of Bad Turbulence. With this original duct system, very bad turbulence was observed at several points, such as at the entry of the lateral with the plenum chamber which was a square turn, at the joints between the telescoping sections, and at the cleats supporting the ducts above the floor which were direct obstructions to the lateral flow of air. In fact, with the velocities inside the ducts being of the order of 2,800 fpm, even the nominal curving of the floor boards caused by warping produced noticeable turbulence. Diagnosis of each little item may appear unwarranted, yet by recognizing their existence we were able to change the resistance to air flow in terms of static pressure in the plenum chamber, from 1.36 in of water to 0.3 in. This was for a 5-ft depth of hay.

Fig. 1 shows the erratic flow of air along the length of the original duct of the existing installation as measured point by point along the air gap through which the air enters the hay. It will be noticed that air velocities range from a positive flow of 2,800 fpm to −600 fpm. The latter reading is actually suction or inflow of air into the duct, which occurred at the joint between two telescoping sections, brought about by air turbulence.

It is startling to realize that points of suction occur in ducts which are almost standard practice today. The static pressure in the plenum chamber for these readings was 1.10 in of water.

Changes in Duct Design. In redesigning the ducts the following changes were made. To streamline or funnel the air from the plenum chamber to the laterals, a short tapered section was designed. It is 2½ ft long with sides and top sloping 25 deg. This is satisfactory, though a rounded metal fitting would be excellent. However, in our work wood construction was retained throughout. The telescoping ducts were discarded; the break between sections creates violent eddy currents, so a single tapered duct was designed. It was tapered to maintain a constant friction loss per foot of length. Also, the supporting cleats were not run crosswise, but fitted on the bottom edges of the ducts. Furthermore, a continuous lateral board was placed under each duct with width the same as the duct top to give a smooth surface on the floor.

The performance of this redesigned duct is shown on Fig. 2. It indicates that the flow of air through the air gaps is uniform throughout the length of the laterals and will dry hay evenly whether it is one foot deep or fourteen.

Method of Figuring Duct Taper. The duct taper was designed to maintain a constant friction loss per foot of length. With this design the velocity was theoretically zero at the end of the duct, and by having a constantly decreasing static head due to flow and a constant air gap for escape, the air distribution was even throughout the duct length. This method of tapering the duct offers all the desired qualities in an air-distributing lateral of this type. (Continued on page 61)

This paper was presented at a meeting of the Pacific Northwest Section of the American Society of Agricultural Engineers at Portland, Ore., October, 1946.

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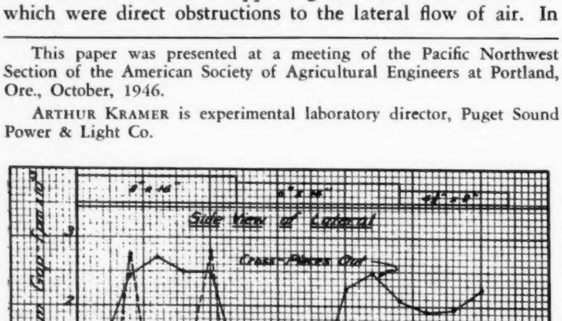

Fig. 1 This graph shows the erratic flow of air along the length of the original duct

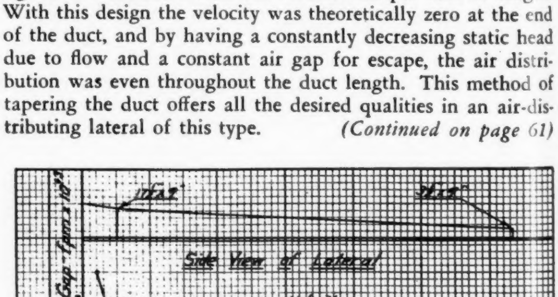

Fig. 2 This graph shows the performance of the redesigned air duct

Garden Tractors for Truck Farming

By Edwin K. Bonner, Jr.
MEMBER A.S.A.E.

SINCE the war, considerable attention has been focused on garden tractors. Many city dwellers are moving to the country and looking to agriculture for recreation and better living. At the same time, many concerns that expanded during the war are looking to this group of people as customers. So far, the garden tractor has proved a very efficient tool mainly for truck farmers. Now these newcomers can learn many valuable lessons from the experience of the truck farmer. Before World War II, about 90 per cent of the garden tractors made went to truck farmers. However, the situation has gradually changed until now only about 50 per cent of those produced are used on truck farms.

There has been an increase of about 11 per cent in the number of small farms under 10 acres since 1940, and 56.4 per cent increase since 1930. The total in 1945 was 561,000 farms. If this trend continues, there should be a similar increase in the demand for garden tractors.

There has also been a considerable increase — about 300 per cent in the past 30 years—in the total truck crop acreage of the 26 leading vegetable crops during the development of the garden tractor, the 1945 total being 3,813,890 acres.

There is now quite a variety of garden tractors on the market, which vary from ½ hp on up. It is generally considered that tractors of 8 hp and over, or tractors which pull 14-in bottom plows or larger, are out of the garden tractor class. The conventional garden tractor is mounted on two wheels, with the engine out in front to balance the weight of the tools which are mounted on the rear between the operator and the wheels. However, some machines have the cultivator out in front; also, some have only one wheel, while others have three or four wheels. Also many garden tractors have riding attachments for use in some operations.

Nearly every garden tractor is equipped with two power take-offs — one to operate at engine speed to drive a duster, a saw, or a mower, and another to operate at low speed to drive a fertilizer agitator or sprayer pump.

Soil tillers are sometimes considered as garden tractors, but more of them are used for greenhouse and nursery work than for truck farming.

The garden tractor was first built, along with the riding-type tractor, about 1904, when six companies were working on various designs. They were not sold, however, until 1915. These tractors were large, and were built mainly with the idea of adapting the then horse-drawn tools to them. This type tractor gradually developed into the present general-purpose tractor. About 1920 smaller garden tractors under 2 hp, were developed. These machines might better have been called motor hoes, for they were built with the idea of using the hand tool equipment, then being used on the wheel hoe and other small hand tools.

In 1919, several of our company's hand tools were made heavy enough for tractor use, and in 1921 a tool bar was first sold for use on various makes of tractors with an overhead hitch. The next year a cultivator was cataloged for use on any garden tractor over 700 lb. From the experience gained by mounting seeders and cultivators on other makes of garden

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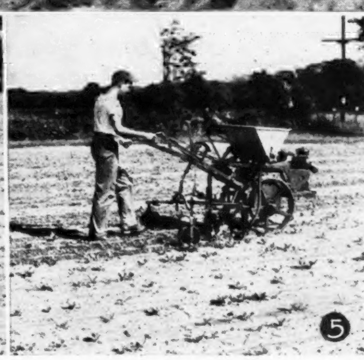



Fig. 1 Planet Jr. garden tractor with disk attachment • Fig. 2 A garden tractor seeding three rows at a time • Fig. 3 Fertilizer attachment combined with seeder • Fig. 4 Planet Jr. garden tractor with four-row duck foot cultivator attached • Fig. 5 Cultivator with hoes and fertilizer attachment mounted on a garden tractor • Fig. 6 Planet Jr. tractor with equipment for chemical weed control

tractors, our company brought out what is called the AT tractor in 1929.

The first operation we usually think of in connection with farming is that of plowing. The use of the garden tractor for plowing is more popular with the home gardener than with the truck farmer, because the former has no other power unit and is satisfied with a shallower job of plowing. The truck farmer generally has a heavy tractor which is better adapted to plowing, but is not as efficient as the garden tractor for seeding and cultivating.

After plowing, the next operation is disking. The disk attachment (Fig. 1) is often used in truck farming to loosen the ground between plantings or just before seeding to kill all weeds. After disking, the ground may be levelled off with a 2x4 plank mounted on standards on a cultivator attachment of the tractor.

The main operations for which the garden tractor is used on truck farms are seeding and cultivating. Fig. 2 shows a tractor with a three-row seeder. Behind the seeders are disk coverers which are used in the summer to put a protective layer of dirt over the seed while germinating. This holds the moisture and, after the seed has sprouted, this ridge is removed with a wooden scraper or slide behind the tractor. At the same time, the crust is broken so the tender sprouts can push up through the surface.

Fig. 3 shows a fertilizer attachment on the seeder, which places the fertilizer either under or to the side of the seed as required for best germination and development.

After seeding, comes cultivating. Our company's present garden tractor is quite well adapted to this purpose. It is shown in Fig. 4 equipped with a four-row cultivator with duck feet, which are flared out at the bottom to stir up the ground but are narrow at the surface so very little dirt is moved, thereby leaving a fine mulch. A lot closer work can be accomplished with garden tractors than with other tools, because of the close control the operator has over the cultivating tools.

Fig. 5 shows a cultivator with hoes. These are much like sweeps which cut under the surface of the ground, generally less than one-half inch. They have a gradual turn upward at one end to prevent disturbing the plant roots at the row. Fig. 5 also shows the use of the fertilizer attachment for side dressing, in which the fertilizer may be placed alongside each row at any depth.

The use of chemical weed killers has become quite necessary in truck farming. Fig. 6 shows a small gear pump mounted on the front end of a garden tractor. It is being driven from a V-belt pulley mounted on the engine. It pumps the fluid from the tank over the wheels to the cross pipe and nozzles in front of the operator. He can easily see that all the weeds are covered with a spray material. This is a very popular combination in many truck crop areas.

Fig. 7 shows the various cultivator teeth, sweeps, and hillers that may be used on garden tractors for various operations, and Fig. 8 shows hoes and other cultivating tools used on hand wheel hoes that are strengthened for tractor use.

Garden tractors also have a formaldehyde attachment to control onion smut when seeding. They are used for dusting and spraying.

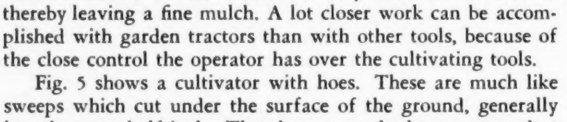
There are other operations carried on in conjunction with truck farming which do not necessarily relate to vegetable growing, for which a garden tractor may be used. One of them is mowing around fence rows, irrigation ditches, or on the lawn with the conventional lawn mower. It may also be used for sawing wood or other belt work, and for moving snow.

There is considerable use for garden tractors in truck farming and other operations and it is important to have the tools properly mounted on the tractor, also for them to be quickly interchanged, so that the least possible time is consumed in changing from one operation to another.

This is accomplished in various ways on different makes of tractors. One method called "jiffy hitch" is to have hooks on one end of the attaching tool. These hooks connect to a swivel yoke which permits the attachment to swivel around the yoke for irregular ground conditions. With this unit there is a connecting point between the rear end of the attachment and the tractor handles. Another method to make the attachments quickly interchangeable is to attach by means of a pin, and still another is to use a quick clamp and connect the attachment to a fixed part of the tractor.

On all operations except mowing, it is necessary to have some flexibility between the attaching tool and the tractor, so that it may be steered and will operate over uneven ground. With most mowers there is a flexible joint between the cutter bar and its drive.

One make of tractor attachment furnishes a handle for steering, while our company's machine has a quick flexible connection on the rear end of its attachments, which is connected to the handles of the tractor, so that when the handles are pumped up or down, the rear end of the attachment moves in the direction pumped, from one side to the other, thus steering the tractor to the right or left, and permitting very close control of the tools. This patented feature is responsible for the great success of our tools.



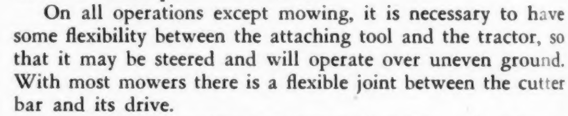


Fig. 7 *(left)* Various cultivator teeth, sweeps, and hillers that may be used on garden tractors • Fig. 8 *(right)* These hoes and other cultivating tools used on hand-wheel hoes are now being strengthened for tractor use

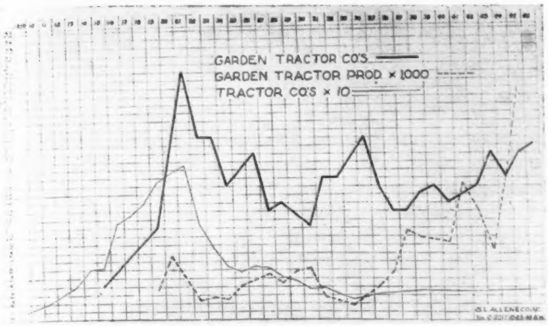


Fig. 9 Graphic presentation of the number of garden tractor companies and quantity of tractors produced

When using any make of garden tractor on truck farms, it is necessary to plan the row spacing to suit the tractor. Some tractors do not have adjustable wheels for various widths of rows, but most of them are adjustable so that a combination may be worked out for both wide and narrow rows. Some farmers plant crops, such as beets and spinach, in narrow rows spaced 10 in apart, carrots at 20 in, and squash in 40-in rows, and have their wheels set at 20-in centers, so they can straddle two 10-in rows, or one 20-in row. Similarly, the various crops can be planted in multiples of 12 or 14 in, with the wheels set at 24 or 28-in spacing, respectively. In some sections, the narrow-row crops, such as spinach, beets, and radishes, should be planted only in 14-in rows, while in other sections, 9-in is found most economical. Many tractors will set narrow enough to straddle one 12-in or 14-in row.

The cost of operating a garden tractor varies a great deal. A round figure of 18c an hour may be given for a 1½-hp machine, and as the number of hours of use per year increases this hourly cost drops rather rapidly. It is interesting to note that a horse may be purchased for much less money than a garden tractor, but it will take 3 or 4 acres of cropland to grow the feed needed for the horse. It is not economical to keep a horse unless the farm contains at least 15 or 20 acres of good cropland.

The accompanying chart (Fig. 9) shows the number of tractor companies as far back as figures are available. It shows that in 1920 the production of garden tractors was at a peak, while the peak of the number of garden tractor companies was not reached until the next year. The total number of tractor companies has remained rather steady within the past few years. It is quite likely the number of garden tractor companies will also remain constant when the present unsettled conditions straighten out, because there is a large number of attaching tools necessary for the user to obtain the maximum value from his power unit.

As is shown by the chart, we are in a period of increase in the production of garden tractors, and this is also indicated by the fact that the four leading garden tractor companies anticipated producing 100,000 tractors in 1946. However, the material and labor situation has dampened their hopes considerably, and it is doubtful if the total production will be over 60,000. Even so, such a figure is way out of proportion to the rest of the garden tractor curve, and also the curve of total tractors. It is, however, indicative of the great demand for garden tractors.

I would like to quote Archie A. Stone in an article, entitled "Garden Tractors on Long Island," published in 1929; he refers to the period around 1920:

"During the years of high production, many models were produced that were not satisfactory and were a source of keen disappointment to their owners. Although the manufacture of most machines of this type has been discontinued, some of them are still offered for sale at prices that might seem attractive to an unwary purchaser. It is extremely questionable, however, if such "orphan" machines are worth buying at any price, and prospective purchasers are warned accordingly. The value and usefulness that has been built into the most of the present day models is a result of several years of experiment and trial, and many of these old models represent ideas that have since been cast aside as entirely inefficient."

We are passing through an interesting period in the development and use of garden tractors.

The great effort now being placed on the development of garden tractors throughout the country will result in a more economical, better operating tool for the truck farmer.

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Duct Design for Hay Finishers

(Continued from page 58)

It is not hard to design such a duct. Heating and ventilating handbooks give charts that are easy to use. Such a chart is usually titled: "Friction of Air Pipes". Reading across the bottom of the chart is friction in inches of water per 100 ft of duct. Reading vertically up the chart is volume of air in cubic feet per minute, and on a diagonal are shown diameters of ducts in inches. In the case of hay finisher ducts, these diameters must be related to rectangular dimensions. Usually, for simplicity in construction, the same width is maintained the whole length of the duct, and the sides only are tapered. So in the use of the handbook chart we assume first a fixed friction loss per unit length, such as 0.4 in of water, and plot corresponding vertical dimensions of the duct, for full volume of air at one end and theoretically zero volume at the other end. Plotting these dimensions on a piece of paper you can actually draw the shape of the taper. This should be a straight slope. In our case the duct was 9 in wide and the sides tapered from 17½ to 3½ in.

New Ducts Gave Improvement. For the same depth of hay, as for example a 5-ft depth, a 55 per cent increase in air volume was realized under actual drying conditions. Here is how it worked out: With the original ducts, under a hay depth of 5 ft the static pressure in the plenum chamber was 1.36 in of water, with an air volume of 11,000 cfm. With the new ducts, an 11-ft depth of hay produced only 0.4 in static pressure and a volume of air 14,500 cfm. A 3-ft depth of hay revealed 0.3 in static pressure in the plenum chamber and an air volume of 18,000 cfm. With a 5-ft depth of hay the air volume indicated was 17,000 cfm or, compared with the reading of the original ducts, a 55 per cent increase, brought about by improvement in duct design.

Artificial Drying of Combined Rice

By Xzin McNeal
MEMBER A.S.A.E.

IN 1929 a rice drier was built at St. Charles, Ark., operated for a short time, and then abandoned. The old plant still stands as a monument to a few who were a bit ahead of their time. No further artificial drying of harvested rice was undertaken by the Arkansas producers until after E. L. Barger, Kyle Engler, and A. H. Thompson were associated at the University of Arkansas in 1942 when the farm size drier was designed and built. Soon after the plant was installed there was a visiting day at the Rice Branch Experiment Station at which many unfavorable comments were made, including references to the drier that had failed at St. Charles. There was one man in the crowd who ventured to say it might work. During the first season of operation 700 bu of rice were dried in the pilot plant, after which the builders corrected many of its weaknesses in preparation for the second drying season.

In 1943 approximately 6,000 bu of rice comprised of four varieties were dried at temperatures ranging from 100 to 140F (degrees Fahrenheit), which gave satisfactory milling results and high germination. After having satisfactory results with temperatures that were in excess of those that had been arbitrarily set, questions arose: What are the proper temperatures for drying rice without injuring the milling results? How much moisture may be removed at one time without injury? What temperatures will affect germination?

On reviewing literature pertaining to the subject, there were more personal opinions than scientific data. Perhaps it was easier, since there were no conflicting data by which one might be misguided. Various driers, ovens, dehydrators, and other related equipment were found to be unsatisfactory in the experimental drying of rice.

This paper was presented at a meeting of the Southwest Section of the American Society of Agricultural Engineers at Fort Worth, Tex., April, 1946. Approved for publication as Research Paper No. 821, Journal Series, University of Arkansas, by the Director of the Arkansas Agricultural Experiment Station.

XZIN MCNEAL is agricultural engineer, University of Arkansas.

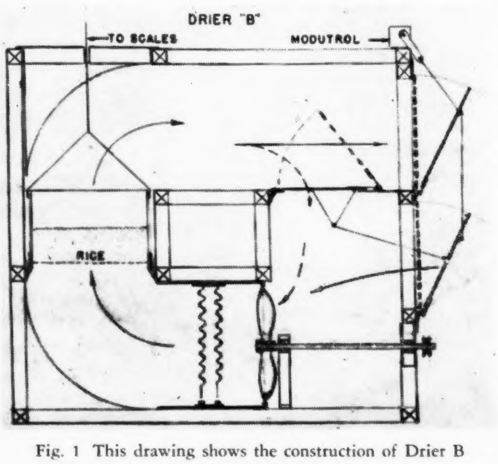


Fig. 1 This drawing shows the construction of Drier B

Three experimental driers have been designed and built: One designated (A) is alternating air flow, continuous grain flow; the second (B) and the third (C) are batch-type units.

Experimental rice drying at the Arkansas station during the past two years has been with five varieties, at temperatures ranging from 100 to 140F on degree increments at one to three drying operations for drying in 1944, and temperatures of 110 to 170F on 20-deg increments with drying completed in one to four operations in 1945.

Drier B, Fig. 1, was designed to recirculate all or part of the air and, to a limited extent, control the relative humidity of the drying air. Electricity was used as a source of heat. Drier C is a batch-type unit and differs from B in that no attempt is made to recirculate the drying air, and the flame from a butane burner is directed into the fan for heat. Drying as reported was done in the two batch-type driers which had trays or baskets with screen bottoms 1 ft square and 8 in deep. The air in each case passed through the rice from the bottom.

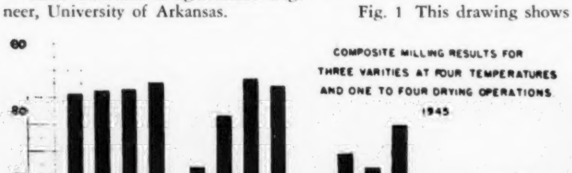
A batch was comprised of about 12 lb of combined rice. When put into the foot-square basket, it was about 4 in deep when drying started. A Steinlite moisture tester was used to determine the moisture content of the rice.

Experimental milling results were made by use of the Smith shelling device as set forth in USDA Circular No. 48. No attempt was made to determine the amount of chalky and red rice or weed seed.

Each batch drier is equipped with a set of scales whereby the weight of the grain may be determined at regular intervals to determine drying progress.

Drying results of 1944 and 1945 were similar, and two temperatures were common to drying operations of both years—110F and 130F.

The batch designation may be explained by an example. In batch P3B4, the first letter indicates the variety of rice (in this case Prelude), the first figure denotes the temperature at which the rice was dried *(Continued on page 67)*



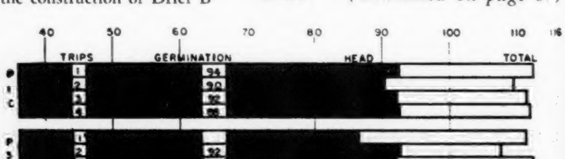


Fig. 2 *(Left)* Composite milling results (1945) for three varieties of rice • Fig. 3 *(Right)* Germination results: head rice and total rice per barrel from artificially dried, combined rice

Wartime Drainage in England

By Elmer W. Gain
MEMBER A.S.A.E.

ABOUT the time of Pearl Harbor the British Government requested direct assistance from the United States on home food production. The request specifically included services of hydraulic engineers for drainage work. By arrangement with the U. S. Soil Conservation Service, two drainage engineers, H. N. Luebcke (a member of this society) and the author, were made available to the U. S. Office of Foreign Agricultural Relations and loaned to the British Ministry of Agriculture and Fisheries. Arriving in England in July, 1942, 2½ years were spent making special drainage investigations and assisting technicians in an advisory capacity. The following are brief highlights of British wartime drainage as observed during this assignment.

Reclamation and drainage was important to Britain's greatly expanded agriculture, which increased domestic food production during the war from about one-third to two-thirds of the total requirements of its 48,000,000 people. Of about 30,000,000 acres in agriculture in England and Wales alone, 4,400,000 chiefly along the coast and its arterial streams (main rivers) require artificial drainage. At the beginning of the war one-third of this area was in poor condition due to inadequacy of existing works. Several million acres scattered over the uplands require field drainage to improve productivity.

By the end of 1944, heavy government subsidies and coordinated efforts of public drainage agencies had accomplished 5644 major jobs on the main rivers, including pumping plants, seawall repairs, and estuary improvements costing $15,480,000; 382 jobs on smaller side streams, primary outlets to farm drains, costing $3,091,200; and farm drainage work on 38,611 field ditches benefiting 2,844,661 acres, costing $12,843,200, on 26,104 tile drains benefiting 188,977 acres, costing $6,040,000, and on 13,914 mole drains benefiting 325,485 acres costing $2,884,000.

The agencies responsible for carrying out this work were the land drainage division of the Ministry of Agriculture and Fisheries, catchment boards, drainage boards, county councils, and county war agricultural executive committees.

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June 1946, as a contribution of the Soil and Water Division.

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The Ministry's land drainage division, through administrative and engineering staffs, allocated drainage materials and machinery and reviewed and approved all government grants-in-aid. Field engineers examined proposals, construction progress, and adequacy of major works. The division investigated and approved new catchment board areas and drainage districts, and also gathered and disseminated data on rainfall, runoff, tide movements, flood control, and farm drainage problems.

Catchment boards, established under a 1930 drainage act, were responsible for major drainageways. There were some 52 boards in England and Wales. Several of the larger catchment areas, such as the Severn, the Thames, and the Trent, were about 5,000 sq mi in extent, comparable to the watershed of the Miami River in Ohio or the Kaskaskia River in Illinois. Each individual board handled an entire watershed or catchment area, determined what portion of the drainage system was main river, and carried out improvements and maintenance on its channel, embankments, and coast line defenses. It exercised supervisory control over any works done by drainage boards or county councils within its boundaries. It levied no taxes but made reasonable assessments against annual revenues of urban and county bodies and drainage boards. It received government subsidies on improvement works in amounts up to 75 per cent of their cost, the actual allowances depending upon ability to pay as determined by the Ministry. By the beginning of the war most boards were well established, had accomplished much of the pioneer work of clearing and shoal removal on major portions of their rivers, and were assisting drainage boards and local agricultural committees in improving outlet channels for farm drainage.

There were some 377 drainage boards, some several centuries old, whose areas comprised small portions of main rivers or watersheds of entire side streams. The limits of their authority extend to the lands they could benefit or protect. It was lack of coordination between several adjoining districts in a single watershed which contributed to the establishment of the single catchment authority. They are set up and operate somewhat like our midwestern drainage districts. They assess taxes for improvements, maintenance, and, if in a catchment area, for catchment board demands. Taxes are

Upper Left: Small model of light dragline with side-arm attachment, developed for excavating field border ditches adjacent to hedge and stone fence • *Lower Left:* Tile trencher development for installation of field tile. Unit mounted on British Fordson tractor, using special tracking gear on drivewheels • *Right:* Detail of tile trencher showing gear-driven rotating disk with cutters.

collected from the occupier, whether a tenant or owner. An occupier must absorb maintenance taxes but, if a tenant, can claim improvement and catchment board assessments from the owner. Drainage boards obtain government grants on Ministry-approved work up to 50 per cent of the cost. Some retain engineers full or part time; many obtain engineering assistance from catchment boards. They assisted on numerous outlet improvements for farm drainage during the war, in some cases carrying out the complete job and in others furnishing only engineering assistance or equipment.

County councils are empowered with the authorities of the catchment board or drainage board on lands outside catchment areas or drainage districts. Except for taxing powers, they could and often did assign their authority for carrying out the work to the local war agricultural committee. In many counties the two agencies operated as a joint organization on drainage work. During the war numerous outlets for farm drainage were cleaned, aided by 50 per cent government grants.

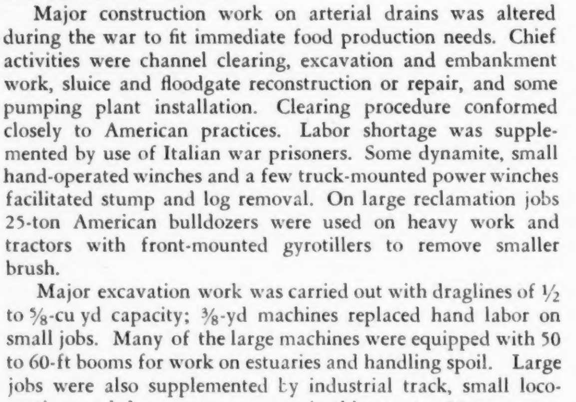
The county war agricultural executive committee was primarily responsible for farm drainage work. It was a group of well-qualified local farmers appointed by the Minister of Agriculture to carry out his war powers within a county. It had authority to determine, advise, and enforce farming practices as directed by the Minister to attain county production quotas. It advised, prepared plans, and approved government grants up to 50 per cent on farm drainage work. It also provided Ministry-owned machinery, hired labor, and carried out such work. Each committee was provided an executive officer with specialized aides, including a drainage officer who also had several assistants.

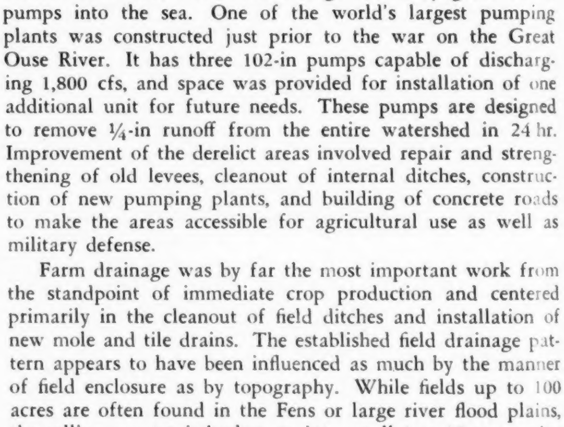
Major construction work on arterial drains was altered during the war to fit immediate food production needs. Chief activities were channel clearing, excavation and embankment work, sluice and floodgate reconstruction or repair, and some pumping plant installation. Clearing procedure conformed closely to American practices. Labor shortage was supplemented by use of Italian war prisoners. Some dynamite, small hand-operated winches and a few truck-mounted power winches facilitated stump and log removal. On large reclamation jobs 25-ton American bulldozers were used on heavy work and tractors with front-mounted gyrotillers to remove smaller brush.

Major excavation work was carried out with draglines of ½ to ⅝-cu yd capacity; ⅜-yd machines replaced hand labor on small jobs. Many of the large machines were equipped with 50 to 60-ft booms for work on estuaries and handling spoil. Large jobs were also supplemented by industrial track, small locomotives and dump cars, common in this country 30 years ago, for removing and spreading spoil or constructing embankments. A great deal of hand labor was still used following machine work, for trimming and dressing up banks. On upper reaches of main channel and side streams, mill dams and sluices — remnants of the water power age — provided drainage obstructions. Some were removed by drainage authorities following purchase from owners, but more often they were altered and repaired so as to lower upstream water levels and increase lateral drainage. Coastal erosion has provided a continuous and troublesome problem. Hand labor was required to keep many small channel outlets open. Use of ditching dynamite had developed by the close of the war a quick method of reopening such outlets.

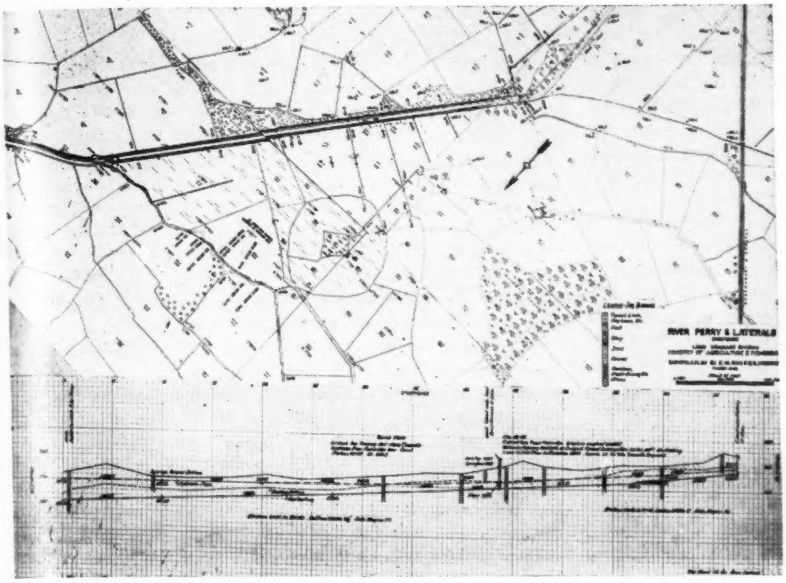
Some of the most valuable and spectacular work from the standpoint of food production was the reclamation of derelict lands such as isolated areas in the Lincolnshire and Cambridgeshire Fens. These Fens, comprising about a million acres of England's most fertile lands, are drained marshes on the east coast, composed of silt soils adjacent to the sea and peat lying to the inland. Continuous improvements have been carried on since the 17th century when Vermuyden, the famous Dutch engineer, laid out and constructed the first main channels to the sea. Internal drainage and cultivation have greatly settled the peat areas so that the lowest lands are now farthest inland with the outlet channels embanked and their beds at and in some cases above land level. Increasing seepage throughout the last century and a half has been progressively overcome, first by wind-driven pumps, next by steam-driven pumps, beginning with Watt's early innovations, and lastly by Diesel-powered units. Examples of all these can be seen throughout this area. Runoff must be handled twice, first by small pumping plants from the small dike districts which discharge their water into the main rivers, and thence from these rivers and storage basins by great outlet pumps into the sea. One of the world's largest pumping plants was constructed just prior to the war on the Great Ouse River. It has three 102-in pumps capable of discharging 1,800 cfs, and space was provided for installation of one additional unit for future needs. These pumps are designed to remove ¼-in runoff from the entire watershed in 24 hr. Improvement of the derelict areas involved repair and strengthening of old levees, cleanout of internal ditches, construction of new pumping plants, and building of concrete roads to make the areas accessible for agricultural use as well as military defense.

Farm drainage was by far the most important work from the standpoint of immediate crop production and centered primarily in the cleanout of field ditches and installation of new mole and tile drains. The established field drainage pattern appears to have been influenced as much by the manner of field enclosure as by topography. While fields up to 100 acres are often found in the Fens or large river flood plains, the rolling country is broken up into small 5 to 10-acre units. They are enclosed by thick hedges, stone walls or earth embankments covered by sod or stones wedged into the top and sides. Since closed fences obstruct free surface drainage, a system of field boundary ditches developed. This is the most





Left: River Perry, Shropshire, June, 1944, following excavation based on plans by Gain and Luebcke • *Right:* View in Cambridge Fens showing low-level, internal district drain behind embanked river outlet view, with water surface of river at higher level. Internal drainage district pumping plant in distance on the opposite side of river



Sample contact print of plan-profile sheet, River Perry improvement scheme, consisting of photographic composite of ordnance survey maps, plotted data on American profile paper, and overlays of north sign, legend and title block used to reduce drafting work. Photostat enlargements used by construction engineer and contractor

common type of field drain. The ditch, placed against hedgerow or wall, is usually narrow, 2½ to 3 ft deep, with 1½ to 2-ft bottom and steep side slopes.

In flat lands, such as fens and moors, ditches are often used both for fence and livestock watering. They are larger and deeper, with penstocks placed across at intervals to maintain water in the channel during dry periods. While this practice was often detrimental to underdrainage, it was frequently the only means of obtaining fresh water. Well water, even considerable distances inland, is often saline and thus not potable.

Due to their small section, prolific growth of grass and rushes, and trampling by stock, field ditches require frequent cleaning. This was normally done in winter months by hand labor. Labor scarcity required development of mechanical cleaning methods. Since a normal dragline boom could not be handled conveniently adjacent to these fences, a special side-arm bucket attachment was developed, permitting it to be dragged on the boom along the ditch bottom. The bucket itself is tapered to fit the narrow channel. By the close of the war the Ministry had in operation about 600 ⅜-cu yd draglines and a majority of these possessed the side-arm attachment. Some hand trimming of hedges was required along the ditches. Several war agricultural committees developed large power-driven saws mounted on tractors which, guided along the hedgerow, were used to cut away overhanging limbs and foliage.

Tile drainage installations paralleled American practices. Round clay tile were used in most parts of England and Wales, although the northern English counties followed the standard Scotch section, corresponding to the old horseshoe tile used in earlier Ohio and Indiana installations. Laterals varied in diameter from 2 to 4 in, the 4-in size being encouraged by the Ministry. Required sizes were determined largely by judgment and not by calculation of hydraulic capacity. Lateral spacings varied, ranging between 2 and 4 rods, and depths from about 18 to 30 in. Most lines were installed by experienced "drainers". They usually followed water grades until sufficient slope was available to make this unnecessary. Instrument-laid lines were exceptional. Mains followed the course of the valley and seldom exceeded 2 miles in total length or 12-in diameter in size. Again, due to labor shortages, mechanical trenching and tile laying was restored to. Several plow-type trenchers were drawn either by direct tractor power or by cable and power winches. A rather promising mechanical trencher was a unit installed on the English Fordson tractor, consisting of a rapidly rotating disk with hook-shaped cutters projecting from the perimeter. It was capable of cutting about 12 ft of 2-ft channel per minute. A number of American tile-trenching machines for excavating larger and deeper trenches were owned and operated by the Ministry.

Mole drains were used extensively on the heavy clay soils, where good slope and free outlet could be obtained. A practical test made by molers to determine if soil was suitable for moling was to compress, with the hands, a sample taken at plow depth into a 2-in ball and immerse the ball in water. If it did not disintegrate after overnight immersion, moling was considered practicable. Moles were usually drawn at depths of 18 to 24 in and spaced 3 to 5 rods apart. Mole size varied between 2 and 3½ in. Several new mole plows were developed, of which the beam types gave best results. These were drawn by the large American track-type tractors that provided the 10,000 to 20,000-lb drawbar pulls required to cut the mole. A few moling plows were drawn by cable and steam-powered tractors. Where heavy land was "ridged and furrowed", moles were usually drawn along the furrows. Moles were often drawn directly into open ditches but better installations provided outlets into tile lines placed parallel to the outlet channel. Moles have been successful in England, probably due to the fact that they are installed on heavy lands requiring drainage but on greater slope than normally drained in this country and the fact that they are drawn below the frost line, which seldom exceeds a foot depth.

Several interesting forms of field surface drainage still maintained on tight soils were the "ridge and furrow" and "grip". The "ridge and furrow" method apparently developed from feudal strip farming. The serf farmed one or more allotments of land, each comprising a strip about 220 yd long and 11 to 22 yd wide, forming a plot a half acre or an acre in extent. To improve drainage, each strip was placed up and down the slope. In cultivating these, a trench or deadfurrow was left on either edge with the soil mounded toward the center. A series of ridges and channels gradually developed, forming a corrugated surface running up and down the slope. Some farmers conceived the idea that corrugations increased

the surface area of the fields and consequently depths between furrows and ridges were increased. Some measurements indicate distances between furrows as varying from 1 to 2 rods and between ridge top and furrow bottom from 1 to 2½ ft. For centuries many were maintained, either by plowing the earth toward the ridge during cultivation or by protective grass cover when in meadow. Today these corrugations interfere considerably with powered tractors and multiple-bottom plows and it is quite likely that many will soon disappear.

"Grips" are found on the reclaimed mud flats adjacent to the sea, where the heavy soil is used only for hay and pasture. They are nothing more than deadfurrows systematically cut across the field at intervals varying from ½ to 2 rods and depths increasing from about 9 in at the center of the field to about 18 in at the field border ditches. Maintenance was usually by hand labor, although a small tractor or horse-drawn trenching plow, consisting of a flat horizontal cutting blade between two parallel coulter wheels, was seen to be used in South Wales.

A few remarks might be made concerning drainage design. Due to the pressure of getting the job done and the limited technical assistance available, detailed engineering surveys and designs, except for large and rather complex undertakings, were infrequent or reduced to a minimum. Hydraulic design, except in a limited and practical sense, was carried out only by the larger catchment board and Ministry engineers.

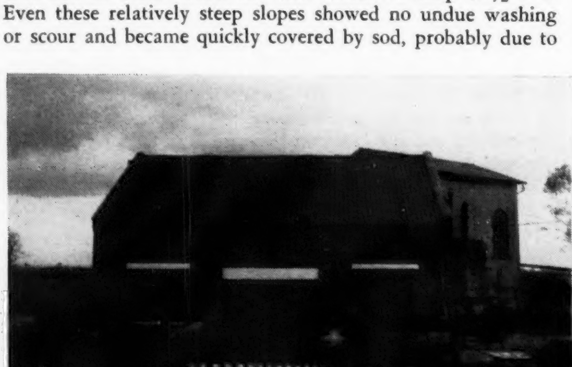
There is no marked difference between flood and drainage requirements in agricultural areas. Being insular and high in the temperate zone, there is no great variation in rainfall throughout the year. Extremes in intensity and corresponding surface runoff common to our continental climate are seldom experienced. Eastern and southeastern England, the normal grain-growing areas, average around 22 in of rainfall per year. Western England and Wales, suited primarily to hay and grazing crops, average between 30 to 35 in per year, increasing up to as high as 150 in in some parts of Wales. For agricultural drainage an old "Fen rule" providing for a daily discharge of 1 per cent of the mean annual rainfall has been rather successfully used by many engineers. This means a drainage coefficient of about ¼ to ⅜ in for agricultural land. Some catchment boards use Rational and other formulas, guided by runoff values established by Kuichling. Except for discharge measurements of the River Thames, at London, no longtime runoff records are available. The Ministry, along with several of the catchment boards, had obtained only a few years' records on their streams just before the war.

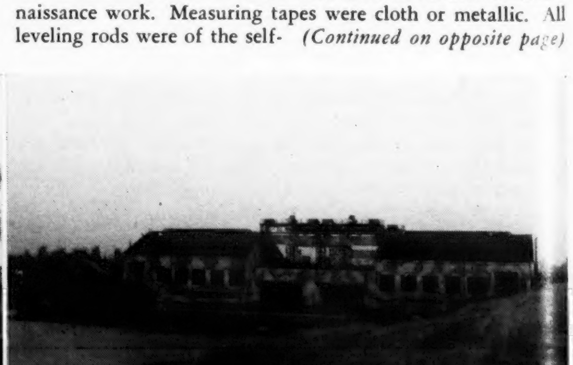
Generally channel sections can be designed with much steeper side slopes than in the states; 1 to 1 slopes were common and on small outlets and field ditches as steep as ½ to 1. Even these relatively steep slopes showed no undue washing or scour and became quickly covered by sod, probably due to the lack of intense sun, abundant moisture, and freedom from severe frost action.

Channel erosion problems are largely confronted in the coastal areas from storms and tidal action and have necessitated design of expensive training walls and surface protection, such as stone riprap, on many of the larger rivers.

Some differences from American practices were noted on the surveys and preparation of job plans. Plats or plan sections were required for all jobs receiving government grants. Profiles and cross sections were included only with the larger and more complex jobs. Copies or tracings of ordnance survey maps which have been made of the entire country were available for use as plan sections. Ordnance map accuracy and detail were such that little if any topographic surveying was required, despite the fact that some maps were many years old. A smaller 1-in per mile map was useful for determining watersheds. A 6-in per mile map (popular among engineers), which included all field boundaries, could be used for plan sections of most proposals requiring profiles. A 1 sq in per acre size, containing detailed information such as bench marks and their elevations, field boundaries with their acreage and identification numbers, stream bank lines, and real improvements to scalable dimensions was satisfactory for the most detailed plans. Field surveys usually provided data for profiles showing elevations of ground line, water surface, channel bottom, and the essential parts of any control structures, such as the sill of a sluice, the crest of a wier, etc. Cross sections ordinarily were taken only at noticeable changes in alignment or channel dimension. When plotted, profiles were shown on plain paper as vertical projections from a given datum along a horizontal distance scale. American practice of indicating 100-ft stationing was not used. Profile areas above the water surface, the portions occupied by water, and the cut sections to proposed new grade were invariably colored, usually in accordance with a standard color scheme. Profile paper, common to American engineers, was not in standard use. Cross sections, when taken, were identified by letters (as A—A) and these locations marked on the plan and profile sections. They were usually plotted in the same manner as the profiles. Standard cross-section paper was used to some extent by Ministry and catchment board engineers. Tracing linen was plentiful and inexpensive, and blueprint and other reproduction paper was generally of the finest quality.

Engineering equipment differed somewhat from ours. Their levels were generally well built, having rather large tripod bases, three leveling screws, and short telescope barrels with non-erecting lenses. Their 14-in telescope had about the same light-gathering properties and magnification as American 18-in instruments. Locke hand levels were in common use for reconnaissance work. Measuring tapes were cloth or metallic. All leveling rods were of the self- *(Continued on opposite page)*





Left: New internal district pumping plant built during the war. Old plant in background • *Right:* Main river pumping plant at St. Germans showing forebay and trash racks. Present capacity 1,800 cfs, draining 180,000 acres

Ground Water in Agriculture

III. GROUND WATER IN NEBRASKA

By G. E. Condra

GROUND water service as it relates to Nebraska is that the geological and water surveys of the Conservation and Survey Division, cooperating with the U. S. Geological Survey, has the duty of studying and describing the ground water resources of the state. We cooperate with the federal survey on definite aerial projects and are making a broader survey than this of the regions of the state. Several publications have been issued and others are on the press. The law of the state requires the Conservation and Survey Division to assist farmers, municipalities, and others in the location and development of water supplies, this service to be based on factual data obtained through survey.

We have passed upon the location and improvement of more than one-half of the municipal water supplies of this state and have a continuous contact with the well drillers of Nebraska in a service for the location and development of sanitary farm water supplies. Our Survey conducts the largest well drillers annual short course in the United States. The state department of health through its sanitary engineer is in close touch with our work. The agricultural engineering department of the college of agriculture offers a cooperative service in types of wells and pumping installations. One of our leading contacts in the water-use program is with the soil conservation districts, which cover most of Nebraska. The movement here is for the conservation of both soil and water, and in the planning for the district it is necessary to supply data for farm wells and for irrigation wells. This is an outlet for the Conservation Division, the chief of which is chairman of the state soil and water conservation committee.

This state, with membership on the Northern Great Plains Agricultural Committee, has emphasized from the beginning the importance of rural water supply and has urged the bordering states to perfect a program of survey and research that will afford facts and service to agricultural water users in this field.

As I see it, there is need in most states for the integration of water use for domestic and municipal purposes, water power and irrigation, and this we are trying to do in Nebraska, keeping in mind all the time the need for flood control and storage of flood water for beneficial use.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

G. E. CONDRA is dean, conservation and survey division, University of Nebraska, and state geologist for Nebraska.

Drying Combined Rice

(Continued from page 62)

(130F), with the "one" and "zero" omitted; the second letter indicates that drier B was used, and the last figure represents the number of drying operations or trips for that batch.

An attempt was made to show the correlation between the rate of drying and head rice yield per barrel. That was done, to some extent, in that higher head rice yields were secured by medium and lower temperatures.

The composite data of drying at 110F for the three varieties indicate that there is a very slight increase in head rice per barrel as the number of drying operations increase from one to four. There is a decided decrease in drying time between one and two dryings, and the total time for drying decreases slightly with the three and four operations. These data indicate that, if drying is done at 110F, it would be most economical at two or three operations.

At 130F drying there is a uniform increase in milling results from one to three operations, and there is very little difference in rice dried three and four times. There was a corresponding decrease in drying time from one to four operations. These data indicate that drying at three trips at 130F is quite satisfactory for most rice. Germination is good under drying conditions. The time is further reduced by drying at 150F; however, there is a corresponding reduction in head rice per barrel. Low milling yield is especially noticeable where the rice was dried in one operation at higher temperatures. Germination is materially affected by these conditions. At 170F the drying time is reduced below that of 150F and likewise the milling yield and germination are lower.

It is evident that further research is necessary to determine the most economical drying temperature for the various varieties, and the number of drying operations. The possibility of using different temperatures on drying rice might be considered, that is, to use higher temperatures possible on the first operation and reduce the temperature with each succeeding operation.

There are still numerous questions to be answered about drying, but one that still hangs in the balance is: Is it the temperature to which rice goes during the drying operation, or is it the rate of drying, that reduces milling results, or both?

Wartime Drainage in England

(Continued from opposite page)

reading type; no targets with vernier were seen. A 16-ft telescopic highway rod was used but was heavy and unsuitable for drainage work. Other rods were rather frail for rough and frequent usage generally given them in this country. Most drafting equipment was of excellent quality. However, planimeters were scarce and seldom used. Areas were commonly measured by the grid method. Slide rules were all of the standard Mannheim type. No special engineering slide rules were observed. Calculating machines for engineering use were unheard of.

Problems frequently confronting the British engineer include conflicts with fishing interests opposing channel improvements, and complex hydraulics and damage claims that arise in connection with numerous sluices and wiers of bifurcated channels which when altered affect water rights, long established and privately owned.

In the postwar thinking of those intimately concerned with land drainage are extensive schemes necessary for completing regulation of arterial channels to meet modern needs. Thought is also being directed at such other related problems as obtaining runoff data, developing research in field drainage, and expanding university training of engineers to include more specialized needs, such as channel hydraulics, agricultural economics, etc.

New Federal and State Bulletins

"Pressures and Other Factors Affecting Silo Construction," by J. R. McCalmont, W. C. Krueger, and Clude Eby. New Jersey Agricultural Experiment Station Bulletin 731, November, 1946.

"A Bimetal Differential Thermostat," by F. D. Yung. Nebraska Agricultural Experiment Station, Agricultural Engineering Progress Report No. 16, January 1947.

"Progress Report on the Investigation of the Various Uses of Electricity on the Farms of Washington for the Year 1946," by J. Roberts and L. J. Smith. Washington Committee on the Relation of Electricity to Agriculture, January 1947. Mimeograph, limited distribution.

RESEARCH NOTES

(A.S.A.E. members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.)

RESEARCH-Marketing Act Explained. At the A.S.A.E. Southeast Section meeting in Biloxi, Miss., on January 14, A. W. Turner explained the provisions of the Research and Marketing Act of 1946 ("An act to provide for further research into basic laws and principles relating to agriculture and to improve and facilitate the marketing and distribution of agricultural products"), and related them to the prospects for federal aid in agricultural engineering research. When maximum funds authorized by this act are appropriated, they will almost triple the federal-grant money to the state agricultural experiment stations and will approximately double the support for research in the Department of Agriculture.

Discussed in Congress as the Flannagan-Hope bill, Mr. Turner explained that this legislation was based on the idea that research could function as an economic stabilizer with outstanding possibilities of increasing farm income through higher yields and the development of new markets for farm products. The war record of agricultural production owes much to research and justifies the conclusion that public funds spent in agricultural research pay rich dividends.

An important feature of the Research and Marketing Act is its emphasis on cooperation in research—between states on common problems, between states and the Department of Agriculture, between agencies or bureaus within the Department, and between any of these groups and private or industrial agencies. Cooperation is perhaps more significant in the engineering phases of agricultural research than in any of the others. Working together, scientists and engineers can find the answers to many problems which otherwise might seem insurmountable. Work within the Department of Agriculture and between the Department and the states has emphasized this coordinated approach increasingly in recent years, Mr. Turner said, and there has also been a closer degree of cooperation between the public research agencies and private industry.

Another point about the Act to which Mr. Turner called the attention of all research workers in agricultural engineering is that it provides for new research. It does not merely permit the continuance of studies under way before and during the war. Individual projects must be justified for support under the Act in terms of original approaches to the solution of agricultural problems. Here is the opportunity for regions and states to plan with vision and imagination for the betterment of farm life and farm business.

The new program, Mr. Turner said, is the big challenge to agricultural engineering in 1947. It offers a great opportunity for expansion of research in this field by the public service agencies and for placing these activities on a sound foundation. The state experiment station directors have indicated interest in expanding agricultural engineering research. It is largely up to agricultural engineers in the state stations to develop the projects and program.

* * * *

Planning New Farming Buildings Research. Current interest of research planners is centered on the "Regional Research Fund, Office of Experiment Stations," authorized in Section 9-b-3 of Title I of the Research and Marketing Act. This section provides that $625,000 may be appropriated for the 1947 fiscal year and $1,250,000 for the 1948 fiscal year for cooperative regional projects on problems that concern the agriculture of more than one state. The projects are to be recommended by a "committee of nine" made up of two agricultural experiment station directors from each of the four regions and a home economist representing the country as a whole.

Director L. D. Baver of the North Carolina station is chairman of the experiment station committee of nine.. Other members are Directors C. E. F. Guterman of New York, W. H. Martin of New Jersey, Clarence Dorman of Mississippi, R. H. Walker of Utah, R. E. Buchanan of Iowa, H. J. Henney of Colorado, Associate Director Noble Clark of Wisconsin, and Dr. Agnes Fay Morgan, head of the home economics department, California station. The committee is already functioning and has directed that initial projects for submission to it fall into 9 broad fields of investigation: (1) food and human nutrition; (2) rural housing and farm structures; (3) marketing, including processing and distribution of agricultural products; (4) discovery, introduction, and improvement of new and useful plants, with emphasis on industrial use; (5) cotton and research; (6) development of more effective methods of maintaining and improving fertility, physical properties, and productivity of the nation's soils; (7) diseases of farm animals, including poultry; (8) animal breeding, and (9) breeding of improved strains of major field and horticultural crops.

Regional meetings on farm buildings and rural housing held during January indicate how project planning is proceeding. The directors of agricultural experiment stations, acting through the Committee on Experiment Station Organization and Policy of the Association of Land-Grant Colleges and Universities, have appointed the following men as referees or administrative advisers to coordinate the work on farm buildings and rural housing: For the northeast region, Director W. H. Martin of New Jersey; for the southern region, Assistant Director F. S. Chance of Tennessee and Vice-Director L. E. Hawkins of Oklahoma; for the north central region, Director Edmund Secrest of Ohio, and for the western region, Assistant Director R. S. Besse of Oregon.

The Committee of Nine and the USDA Office of Experiment Station officials have agreed that farm buildings and rural housing constitute one of the main subjects for study under the regional research fund and should receive a large allocation from the first money made available. The appointed referees will present coordinated programs from their respective regions to the Committee for immediate consideration, in order that Congress may be requested to appropriate funds for use during the remainder of the current fiscal year.

To prepare these programs the referees called the January meetings of technical workers representing each state and the USDA. Representatives of the building materials industry were invited to attend the northeast meeting at New Brunswick, N. J., January 16-17, and the north central meeting at Chicago, January 17-18. The southern region representatives held their meeting at Biloxi, Miss., January 13-14, coinciding with the meeting of the Southeast Section of A.S.A.E., and the western meeting was held at Berkeley, Calif., January 15-16.

All four regions recommended projects on requirements for rural housing and design of improved farmhouses. The northeastern, north central, and western groups asked for projects on the housing of dairy cattle, and the northeastern and western on poultry housing. The southern region suggested studies on the conditioning and storage of grain, seeds, forage crops, and tobacco. The north central region wished to study the handling, processing, and storing of livestock feeds with particular emphasis on labor saving. Housing requirements for beef cattle, sheep, and swine were proposed by western representatives. That group and those from the north central and southern regions were also interested in studies on the utilization of materials, particularly in the farmhouse.

In addition to the regional research fund, the Act authorizes other funds for experiment stations and the USDA. Federal funds to match state money for agricultural research other than utilization, plus the small amount allotted to the USDA Office of Experiment Stations for administration, can together equal three times the amount of the regional fund. Many states have already appropriated enough money for research of this kind to take care of the matching requirement for the current year. The funds allotted directly to the states provide an opportunity for many farm buildings or farm housing projects in addition to those included in the regional program. Careful coordination of work authorized under the several sections of the Act will assure realization of its maximum benefits.

* * * *

New Spraying and Dusting Techniques. While corn borer control by means of light traps is coming in for intensive investigation, engineers of the USDA Division of Farm Power and Machinery are working on more effective application of chemical insecticides in combating this pest. In connection with hydraulic spray experiments, sprayer stalk guide attachments recently have proved effective. Without the guides, standard hydraulic spray applications gave a borer reduction of 86 per cent in the entire plant. With stalk guides attached, the same sprayer with the same dosage rate and operating conditions gave a borer reduction of 95.2 per cent.

Field tests of a new duster developed to study variation and control of air-volume delivery showed that as air volume and velocity increase control of borers improves. With 62 cu ft of air per minute the number of borers was reduced 62.9 per cent in the ears and 68.1 per cent in the stalks. At 220 cfm, the borer reduction in the ears was 84.1 per cent and in the stalk 76.3 per cent.

For the application of fungicide material a combination sprayer-duster has been developed which gives three times the initial deposit and after weathering a rain, 3.4 times the final deposit obtained with standard dust applications. Compared with a standard hydraulic spray on potatoes, the combination applications gave a 59 per cent greater initial deposit and a 33 per cent greater final deposit.

The work on insect and plant disease control equipment is carried on at the Toledo, Ohio, laboratory in cooperation with the Bureau of Entomology and Plant Quarantine. Frank Irons is the USDA agricultural engineer in charge.

* * * *

BPISAE Reports 1946 Work. The Department of Agriculture has just announced publication of the annual report of the Bureau of Plant Industry, Soils, and Agricultural Engineering covering the fiscal year 1946. Dr. Robert M. Salter, chief of the Bureau, writes that "cumulative results of research aimed at better production, harvesting, and storage of crops have never been more evident than now." The Bureau's research is removing some limitations on farm production and helping the farmer adjust his operations to meet others. (Continued on page 70)

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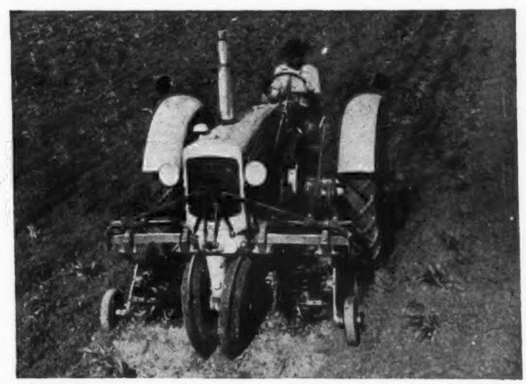

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RESEARCH NOTES

(Continued from page 68)

A total of 150 items on various phases of fundamental and applied research appear in the several sections of the report. They tell what contributions have been made towards helping farmers with their problems of keeping up soils, getting better yields of better quality crops, improving the efficiency of their machinery, storage, and transportation.

Examples cited from the work of the Divisions of Agricultural Engineering include accounts of reductions in soft corn losses through storage studies, development of "shell cooling" in potato storages, improvements in sugar cane and sugar beet mechanization, special equipment for ginning machine-picked cotton, changes in mow hay drier design, and development of low-cost farm egg-cooling systems.

* * * *

F.E.I. Industry Research Conference. Secretary of Agriculture Clinton P. Anderson is scheduled as the welcoming speaker at the annual spring industry-research conference on farm power and machinery sponsored by the Farm Equipment Institute. Plans are being made to hold the conference at the USDA Agricultural Research Center, Beltsville, Md., March 3 and 4.

The full agenda for the two-day program has not yet been completed, but it will include discussions of new research under way on a wide variety of subjects relating to crop production and harvesting problems and equipment. Topics tentatively selected include: Application of weed killers, mineral and trace elements in the soil, length-of-day studies, nematodes and their control, soils and soil dynamics, research in farm power and machinery as related to the F.E.I. research program, mechanical processing of farm products, research on fertilizer placement and equipment, development of machines and equipment for pest and plant disease control, how public service agencies can best serve the small farm machinery manufacturer, airplane spraying with a demonstration of methods, and farm electrification research in relation to machinery and equipment. Other subjects may be scheduled for discussion and other changes may yet be made in the tentative program.

The evening session of March 3, following dinner at the Log Lodge on the Research Center grounds, will be devoted to discussions of activities and work of the Agricultural Research Administration and its various bureaus with particular reference to the problems of the farm equipment industry.

The March meeting will be the third such research conference sponsored by the F.E.I. Two years ago a similar program was held at the University of Illinois at Urbana. Last year the conference was at the Alabama Polytechnic Institute and the U. S. Tillage Machinery Laboratory at Auburn, Ala.

* * * *

Dehydrated Air for Seed Drying. At its field station in Athens, Georgia, in cooperation with the agricultural engineering department, University of Georgia, the USDA Division of Farm Buildings and Rural Housing has established a research project on small grain and seed drying. The need for artificial drying has been magnified by the rise in acreage harvested by combining, for grain and seed crops are combined while the moisture content is still high. Increased production and the shortage and high cost of labor for handling also result in more grain storage and emphasize the value of obtaining rapidly a moisture content low enough for successful long-term storage.

The germination of seed is markedly affected by high temperatures at high moisture content, so it is particularly important that grain to be used for seed be dried rapidly. Blue lupine seed is a relatively new crop in the Southeast, where this legume is growing in popularity for soil-building and forage. J. W. Simons, USDA agricultural engineer at Athens, has built an experimental drier for blue lupine seed using chemically dehydrated air. This type of drier has certain advantages over heat driers in that danger of overheating the seed and injuring germination is eliminated, as is the fire hazard.

Simons is using calcium chloride in the experimental drier and is remodeling the setup to increase the tray area. The path of air flow will be by a circuitous route over the surface of the flakes rather than up through the calcium chloride. He thinks 20 per cent moisture content seed can be reduced to 12 per cent at a cost for calcium chloride not exceeding 0.3c per lb. Activated alumina may also offer some possibility for this use, as it would not be too difficult for a farmer to reactivate this product and reuse it many times.

* * * *

Championship Farmers to Visit Beltsville. Another large group under industry sponsorship will visit the USDA Agricultural Research Center at Beltsville in February. The group will consist of 120 "championship farmers" selected under the auspices of the Firestone Tire and Rubber Company, representing 31 states. Accompanied by their wives, they will spend three days in Washington, one of which will be spent at the Research Center. They will make a tour of the many laboratories, field plots, and barns to observe research now under way, including the work of the Divisions of Agricultural Engineering.

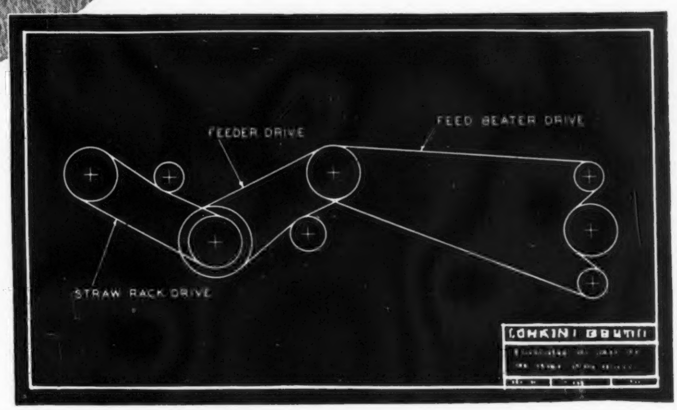
DO YOU KNOW ROLLER CHAIN . . .

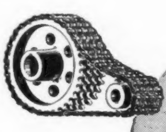
is right where shaft centers are fixed?

(1) **ROLLER CHAINS** offer the most versatile means of timing and transmitting positive power between shafts whose centers are fixed.

(2) **BALDWIN-REX** roller chains and sprockets in this combine assure maximum production—there is no slippage to waste grain. Roller chains are easy to install and require less space per horsepower transmitted than with any other medium. No elaborate mechanisms are needed to compensate for stretch, as roller chains do not rely on tension for effective operation.

(3) **AS THIS COMBINE DRIVE DIAGRAM** indicates, small sprockets are used to transmit power on both long and short center distances. All machine functions are accurately timed because of positive power provided by roller chains. With proper care, they last the lifetime of the machine. Speed changes are easily made by simply changing sprocket size.





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ROLLER CHAINS

Write for competent information and assistance on your specific drive problems, or for catalogs on Baldwin-Rex roller chains.

BALDWIN-DUCKWORTH DIVISION OF CHAIN BELT COMPANY

376 Plainfield Street, Springfield 2, Massachusetts

NEWS SECTION

A.S.A.E. Meetings Calendar

March 1—Michigan Area Section, Michigan State College, East Lansing.

April 4 and 5—Southeast Section, Texarkana, Texas.

June 23 to 25—ANNUAL MEETING, Benjamin Franklin Hotel, Philadelphia.

December 15 to 17—FALL MEETING, Stevens Hotel, Chicago.

Nutt Is Chairman Southeast Section

AT THE regular meeting of the Southeast Section of the American Society of Agricultural Engineers held at Biloxi, Miss., January 14 to 16, in conjunction with the annual convention of the Association of Southern Agricultural Workers, Geo. B. Nutt, head, agricultural engineering department, Clemson Agricultural College, was elected chairman of the Section for the ensuing year. Other officers elected are as follows: First vice-chairman, T. W. Edminster, research division, U. S. Soil Conservation Service; second vice-chairman, F. M. Hunter, extension specialist in rural electrification, Mississippi State College, and secretary-treasurer, Harry Dearing (re-elected) agricultural engineer, Tennessee Coal, Iron, and Railroad Company.

Ninety-seven members and friends of A.S.A.E. registered for the meeting, and a very timely and interesting program was presented.

National Farm Electrification Conference

ACCORDING to an announcement just received, the 1947 National Farm Electrification Conference will be held Tuesday and Wednesday, October 7 and 8, at the Claypool Hotel, Indianapolis, Ind.

Personals of A.S.A.E. Members

Dale L. Bidwell, who served as a lieutenant in the U. S. Naval Reserves during the war, is now associated with the U. S. Soil Conservation Service at Tyler, Texas, as agricultural engineer on soil conservation districts.

D. A. Beckenbaugh has been promoted from assistant works manager of the J. I. Case Company at its Rockford Works, Rockford, Ill., to plant manager.

John T. Blakely, who served as an officer in the armed services during World War II, is now employed as parts and service manager of Blakely Motor Sales, Welch, W. Va. His company is agency for Packard and Hudson motor cars and International Harvester motor trucks.

Floyd J. Bunger is now territory supervisor for the Rock Island Branch of the J. I. Case Company, with headquarters at Platesville, Wisconsin. Previous to this connection he was employed by Glenn L. Martin-Nebraska Company as tool engineer.

Sherwood S. DeForest, who was an engineering officer in the U. S. Army Air Force during the war, is now a graduate student and half-time instructor in agricultural engineering at Iowa State College.

Edgar E. Erwin, Jr., who served as an officer in the Army Engineers during the war, is now an engineer for roads, bridges, and parish-wide drainage, for the East Carroll Parish Police Jury Highway Department, Lake Providence, La.

Ward H. Henden, who served as an officer in the 41st Armored Infantry of the U. S. Army during the war, is now employed as an engineer by the South Dakota Highway Commission and is located at Huron.

Paul Huey, who when released from the armed services some time ago was serving as a lieutenant colonel at the Pacific area headquarters of the Air Service Command, is now western manager of "Progressive Farmer," with headquarters in the Daily News Building, Chicago.

Donald M. Kinch recently resigned as chief engineer in charge of the agricultural division of Climax Industries to accept appointment as assistant professor of agricultural engineering at Iowa State College.

Homer C. Mauer, formerly employed as engineering draftsman with the Consolidated Vultee Aircraft Corp., is now professor of engineering at Bluefield College at Bluefield, Va.

Nolan Mitchell has resigned as head of the education section, Agricultural engineering development division, Tennessee Valley Authority, to accept a position in the agricultural engineering division of the Aerovent Fan Co., Lansing, Mich. Mr. Mitchell is a graduate in agricultural engineering of the University of Tennessee, and including a period as cooperative student on the agricultural engineering research staff, Mr. Mitchell was associated with TVA for about 10 years.

(*Continued on page 74*)

In 1947 . . . as in 1847
It's good farming
and good business to—

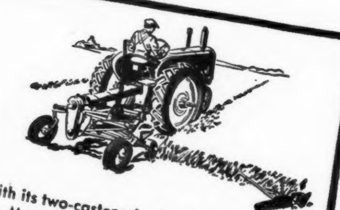
Make it a Massey-Harris

Newest in the Massey-Harris line of farm machinery is the Self-Propelled Corn Picker. It picks corn faster, with less waste.

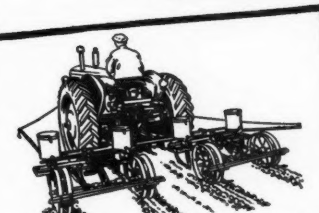
It happened back in the 1840's. Daniel Massey, a Vermont farmer, used to take the crude farm tools he bought . . . improve them as a skilled Yankee would . . . and make his work easier in the field.

Soon he was making tools for his neighbors. Thus did the Massey-Harris organization have its beginnings in 1847. And "Make it Better" is still the guiding principle of this world-wide company.

"Making it Better" developed the rasp-bar cylinder and straight through separation of Massey-Harris Clipper Combines. It pioneered the self-propelled idea in combines and corn pickers. It introduced the "Velvet Ride" tractor seat, "power-plus" tractors, high speed plows, the new Forage Clipper that handles any hay or ensilage crop. It gave Massey-Harris farm machinery a reputation for simple design, better engineering, sounder construction.

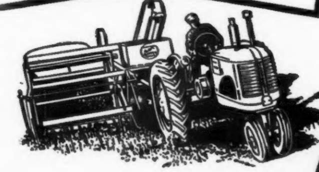


With its two-caster wheels, the semi-mounted Massey-Harris No. 6 Mower does a better job of following the contour of the field... is more flexible... easier to attach.



Massey-Harris Drill Planters drill corn accurately at 5 to 6 miles an hour — up to 75 acres a day with the four-row; 35 to 40 acres with the two row.

Massey-Harris Plows pull easier, scour cleaner, do a better job in trashy conditions. In sizes for all tractors.



Wherever small grains are harvested, Massey-Harris Combines are noted for their clean, complete separation. Either tractor drawn or Self-Propelled.

When Daniel Massey began making farm machinery in 1847, James K. Polk was President of the United States.

MASSEY M-H HARRIS

TRACTORS
COMBINES
IMPLEMENTS

All of which means that with Massey-Harris Tractors and Equipment farmers can do more and better work in less time, with less effort, at lower cost.

The 1947 Buyers Guide, completely describing the entire Massey-Harris line, will soon be ready. We shall be glad to send you a copy. It's FREE. Simply address Department 195.

THE MASSEY-HARRIS COMPANY
General Offices: RACINE, WIS.

Personals of A.S.A.E. Members

(Continued from page 72)

John E. Nicholas, professor of agricultural engineering, Pennsylvania State College, addressed the Ninth Annual Rural Electrification Conference of Georgia held at the University of Georgia, Athens, last month, on the subject, "Facts About Home Freezers and Farm Refrigerators."

Walter H. Redit, who was released with the rank of lieutenant colonel from the U. S. Army Air Force some time ago, has returned to his duties with the agricultural engineering divisions of the U. S. Department of Agriculture, as associate mechanical engineer. He is engaged on insulation tests with refrigeration cars and the current program of testing heaters in apple shipments from the Northwest. The work is being conducted as a joint project with the division of fruits and vegetable crops, BPISAE.

Monroe W. Treiman, who served as an officer in the U. S. Army Air Force during the war, is now co-owner and operator of a farm near Brooksville, Florida, which apparently is being well engineered, with mechanization, irrigation, etc. He will engage in general farming including the raising of cattle and tropical specialties.

Richard N. White who served with the U. S. Army Air Forces during the war, attaining the rank of major, is now sales engineer for the Stran-Steel Division, Great Lake Steel Corporation. He represents his company in the state of Indiana.

E. Buford Williamson, who served with the 667th Engineer Typographic Company during the war is now assistant agricultural engineer (BPISAE), U. S. Department of Agriculture, and is engaged on a research project of mechanization of cotton and other crops conducted jointly by the USDA and the Delta Branch Station of the Mississippi Agricultural Experiment Station at Stoneville.

Necrology

Stanley M. Elliott, manager of agricultural tire sales for the Seiberling Rubber Co., passed away January 3, following an operation on his throat.

Born September 12, 1912, at DesMoines, Iowa, he studied engineering at Swarthmore College in 1930 and 1931, then completed requirements at Ohio State University, from 1933 to 1937, for a bachelor of science degree in agricultural engineering. Following his graduation he went to the University of Illinois to undertake research work on the agricultural engineering aspects of soybean production. As a part of this work he was active in the early development of a mower-crusher.

Early in 1939 he became a test engineer for the B. F. Goodrich Co., at Akron, Ohio, and was assigned to development work on agricultural tires. In November, 1941, he was promoted to manager of testing in the tire division of the company, and was made responsible for development and control testing of all tire division products.

After joining the Seiberling Rubber Co., in March, 1946, as assistant manager of agricultural tire sales, he was promoted to manager of the department in August of that year and continued in that capacity until his untimely passing.

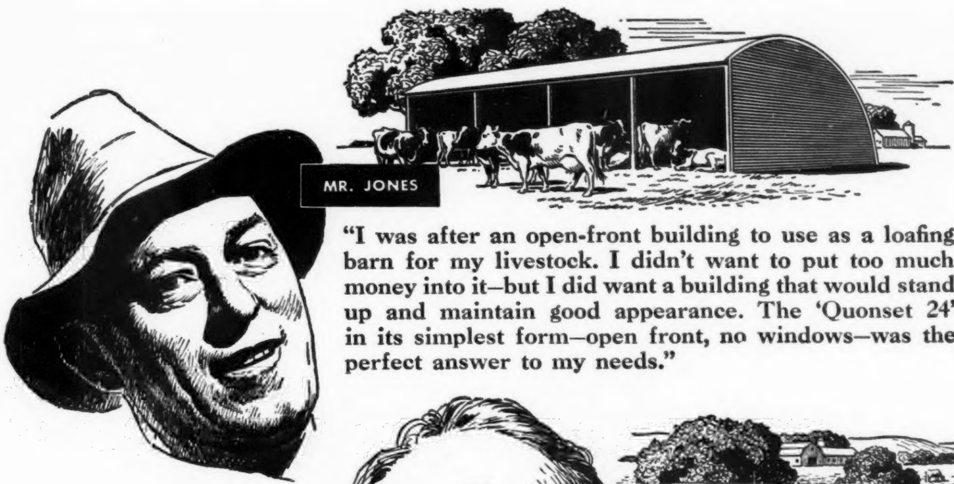
He is survived by his wife, Mrs. Jean Elliott, his mother, a sister, and two brothers.

New Literature

Farmstead Wiring. Paper, 42 pages, $8\frac{1}{2}$ x 11 inches. Illustrated and indexed. Westinghouse Electric Corp. 25 cents per copy; reduced rates on quantity orders for redistribution.

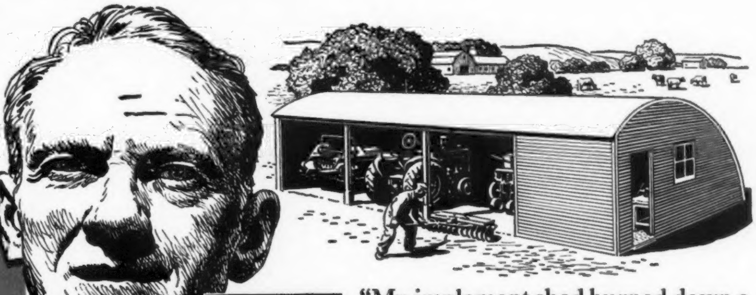
This booklet is designed to help show farmers what good wiring is and what it is worth to them. Under the heading of productive uses there is a check list for items wanted now, soon, or later, showing the activities or uses concerned, advantages of electrical operation, rated load and average energy consumption. Uses are grouped under dairy enterprise, poultry, other livestock, farm shop and machine shed, farm crops, water supply, and farm home. With it a farmer can readily calculate his present and future wire capacity requirements. Another check list is provided on location of electric outlets, to further assist in planning the farm electric distribution layout. Other information included deals with planning ahead for wiring, voltage drop and carrying capacity of wires, interior wiring design, and exterior distribution system.

Elements of Soil Conservation, by H. H. Bennett. Cloth, X + 406 pages $5\frac{1}{2}$ x 8 inches. Illustrated and indexed. McGraw-Hill Book Co., $3.20. An agricultural text and reference presenting the erosion problem in the United States, extent of erosion, effects of erosion, how erosion takes place, rates of erosion and runoff, climate and soil erosion, rainfall penetration, a national program of soil conservation, planning for conservation of soil and water, use of vegetation in soil and water conservation, contouring, terracing, channels and outlets, gully control, control of erosion on stream banks, water spreading, wildlife and soil conservation, small dams for water storage, stubble mulch farming, farm drainage, farm irrigation, and the place of trees and shrubs in soil and water conservation. A list of available visual aids in the form of moving pictures and film strips is appended.



MR. JONES

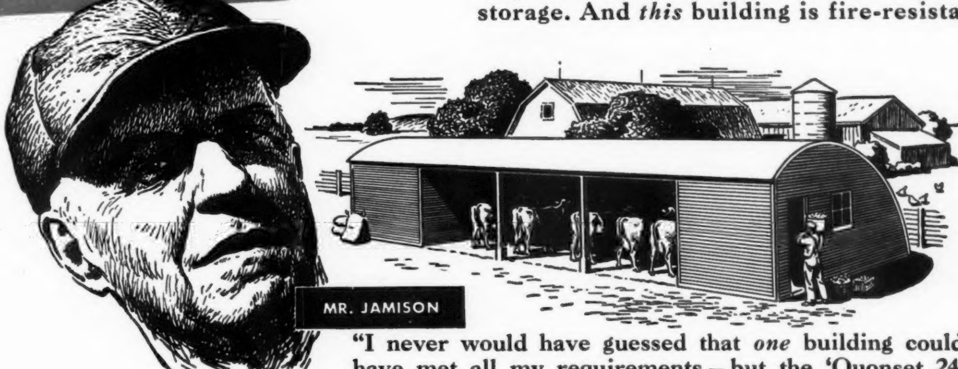
"I was after an open-front building to use as a loafing barn for my livestock. I didn't want to put too much money into it—but I did want a building that would stand up and maintain good appearance. The 'Quonset 24' in its simplest form—open front, no windows—was the perfect answer to my needs."



THREE DIFFERENT WAYS TO LOOK AT THE "Quonset 24"

MR. JENSEN

"My implement shed burned down a few weeks ago. I wanted a new building in a hurry, so my 'Quonset' dealer and I worked out this arrangement of a 'Quonset 24.' One section is partitioned off to use as a repair shop. The other sections are for implement storage. And *this* building is fire-resistant."



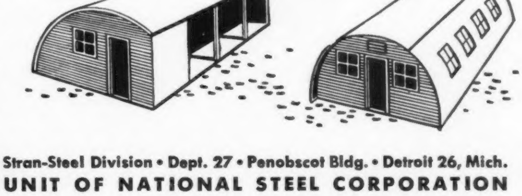
MR. JAMISON

"I never would have guessed that *one* building could have met all my requirements—but the 'Quonset 24' sure did. The end section on the right is a freezing storage room for our truck garden—solid front panel, partitioned off, insulated. The next three sections serve as an open-front heifer barn. And the end section on the left is partitioned off as a feed room, with a sliding door for easy access. It's a real step-saver."

YOU NAIL TO
STRAN STEEL
FRAMING

Put the "Quonsets" to work for you!

The "Quonset 24" and "Quonset 20" are strong, sturdy, fire-resistant buildings, adaptable to scores of uses. They are framed with Stran-Steel, with its *patented nailing groove* for attaching the steel covering, insulation when required, and other materials or fixtures. "Quonsets" save money, save work. See your "Quonset" dealer for information . . . or send us a postcard requesting his name and address if you do not know where he is located.



GREAT LAKES STEEL CORPORATION Stran-Steel Division • Dept. 27 • Penobscot Bldg. • Detroit 26, Mich.
UNIT OF NATIONAL STEEL CORPORATION

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

T. C. Alfred, Jr., manager, Equipment Development Corp., 631 Terminal Tower, Cleveland 13, Ohio

W. S. Anderson, director, bureau of milk sanitation, Pennsylvania Department of Health, Harrisburg, Pa.

Gordon E. Barlow, Jr., student, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) Box 34

Ned J. Bond, Jr., associate agricultural engineer, Louisiana Agricultural Experiment Station, Baton Rouge 2, La.

Richard T. Brown, engineer, National Farm Machinery Co-op., Inc., Belleville, Ohio. (Mail) 153 Gunther St.

Brock N. Burwell, instructor in agricultural engineering, University of Saskatchewan, Saskatoon, Sask., Canada

Andre F. Civil, agronomist, Tuskegee Institute, Ala. (Mail) P. O. Box 609

Donald E. Cleland, farm power advisor, Pacific Gas & Electric Co., 530 E. Street, Marysville, Calif.

Alfred Colle, owner, Alfred Colle Co., 510 New York Life Bldg., Minneapolis, Minn.

Charles E. Converse, general manager and secretary-treasurer, H. D. Converse & Sons, Inc., Phelps, N. Y.

Chester P. Davis, Jr., engineer on farm electric equipment, General Electric Co., Schenectady, N. Y. (Mail) 1025 Trinity Ave.

George C. Delp, general manager, New Holland Machine Co., New Holland, Pa.

William T. Dumas, Jr., graduate assistant in agricultural engineering, Alabama Polytechnic Inst. (Mail) 504 South 8th St., Opelika, Ala.

Norman H. Foote, head, rural engineering dept., Long Island Agricultural and Technical Institute, Farmingdale, L. I., N. Y.

Clyde W. Graham, engineer, Soil Conservation Service, USDA

L. R. Griffiths, resident engineer, The Massey-Harris Co., Batavia, N. Y.

John E. Hendrick, farm tractor engineer, Ethyl Corp. (Mail) 3200 Stanford Ave., Dallas 5, Tex.

C. S. Jonasson, airport maintenance equipment, Canadian Department of Transport. (Mail) 77 Cordova Street. Winnipeg, Man., Canada

George D. Kreuzkamp, assistant chief engineer, The Oliver Corp., Springfield, Ohio

J. T. Kyle, instructor in agricultural mechanics, University of Saskatchewan, Saskatoon, Sask., Canada. (Mail) 717 Main St.

Roy Lundquist, mail-order merchandise manager, plumbing, water systems, and heating systems dept., Sears, Roebuck & Co., 925 S. Homan Ave., Chicago 7, Ill.

J. L. Maquire, agricultural development agent, Northern Pacific Railway Co., 1005 Smith Tower, Seattle 4, Wash.

John H. McCavitt, civil engineer, Soil Conservation Service, USDA. (Mail) P. O. Box 534, Half Moon Bay, Calif.

James F. Merson, head, agricultural engineering department, California Polytechnic College, San Luis Obispo, Calif.

Frederick R. Moody, student agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) P. O. Box A 81, Virginia Tech. Station.

Kurt Nathan, graduate student in agricultural engineering, Cornell University, Ithaca, N. Y. (Mail) 516 Stewart Ave.

Bernard L. Parsons, student, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) P. O. Box 1378, Virginia Tech. Station.

Rayapura V. Ramiah, graduate student in agricultural engineering, Iowa State College, Ames, Iowa

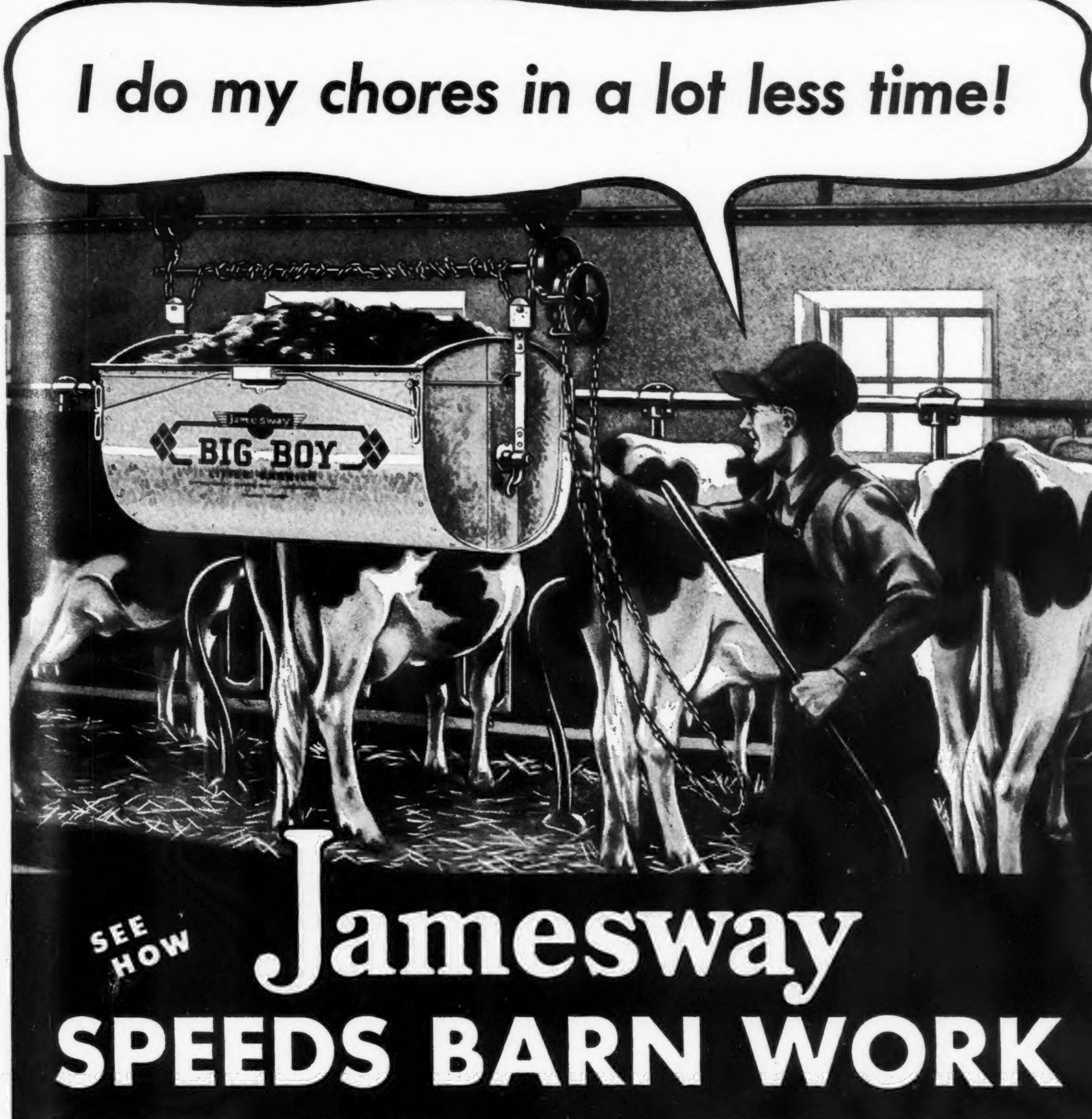
Rajendra P. Saxena, assistant agricultural engineer, Volkart Brothers, 8 Clive Street, Calcutta, India.

George E. Schweitzer, general manager, central division, Rilco Laminated Products, Inc., W-1581 First National Bank Bldg., St. Paul, Minn.

Saranjit Singh, graduate student in agricultural engineering, Iowa State College, Ames, Iowa

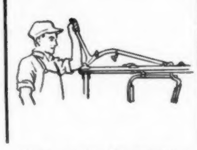
Frederick R. Steese, engineering group leader, farm equipment engineering div., Graham-Paige Motors. (Mail) 5601 Greenway, Detroit 4, Mich.

(Continued on page 78)



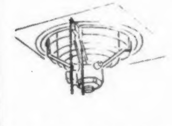
Save up to 40 minutes with the new Jamesway Mile-Saver feed truck. One easy trip does the work of 16 with a bushel basket. Cuts chore time.

Save up to 30 minutes with Jamesway water cups. No more herding of cows around water tanks. No tank heater to tend. Increase milk production 10%.



Save up to 30 minutes with Jamesway patented Lever Stalls. One handy lever locks all the cows in place—releases them all just as quickly. Easy to operate.

Save up to 50 minutes with a Jamesway "long-life" litter carrier. No other like it! One trip does the work of four or five with a wheelbarrow — and a lot easier.



Save time with Jamesway automatic ventilation. No adjustments —regardless of weather. Keeps barn drier, healthier. Promotes efficiency. Reduces barn odors.

Save 4 big ways with Jamesway Hog Feeders. Cut feeding time in half—market early. USDA reports self fed hogs produce 33% more pork with 25% less feed.

Write Dept. A-247 for free folder on how to save time with modern barn equipment. It's full of basic facts that you will want to pass on to your farm friends. For help on any barn planning or remodelling problem, call on your friendly Jamesway dealer.

Jamesway
REG. U.S. PAT. OFF.

Fort Atkinson, Wis.
Elmira, N. Y. Oakland, Calif.

PROFESSIONAL DIRECTORY

Applicants for Membership

(Continued from page 76)

D. E. Stewart, assistant to vice-president, Carolina Power & Light Co., Insurance Bldg., Raleigh, N. C.

James H. Stramler, agricultural engineer, Bureau of Reclamation, USDI. (Mail) 2900 63rd St., Sacramento, Calif.

David N. Summerfield, quality control supervisor, Sta-Rite Products, Inc., Delavan, Wis. (Mail) R. R. No. 3

S. N. Tandon, in charge of agricultural machinery section, Volkart Brothers, Engineers, 8 Clive St., Calcutta, India

Thomas V. Wilson, instructor in agricultural engineering, University of Georgia, Athens, Ga.

Paul N. Winn, Jr., student in agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) P. O. Box U 1383, Virginia Tech. Station.

Thomas B. Worley, agricultural engineer, Mississippi Power & Light Co. (Mail) Jackson, Miss.

K. Siang-kan Wu, graduate student in agricultural engineering, Iowa State College, Ames, Iowa

TRANSFER OF GRADE

W. F. Ackerman, instructor in agricultural engineering, Pennsylvania State College, State College, Pa. (Associate Member to Member)

Albert M. Best, in charge of farm machinery research and development, New Holland Machine Co., New Holland, Pa. (Junior Member to Member)

Leonard W. Bonhorst, engineer, Bureau of Reclamation, USDI. (Mail) Box 688, Pierre, S. D. (Junior Member to Member)

Robert A. Breckenridge, hydraulic engineer, U. S. Bureau of Reclamation, USDI. (Mail) 414 E. Greenwood Ave., Bend, Ore. (Junior Member to Member)

Sidney Buckaloo, assistant soil conservationist, Soil Conservation Service, USDA. (Mail) Darlington, Wis. (Associate to Member)

D. H. Daubert, research division, J. I. Case Co., Racine, Wis. (Associate to Member)

Paul E. Harbison, work unit conservationist, Soil Conservation Service, USDA. (Mail) Dighton, Kan. (Junior Member to Member)

Leo W. Larsen, engineer, John Deere Harvester Works, Deere & Co., East Moline, Ill. (Mail) 2912 11th Ave. "B", Moline, Ill. (Junior Member to Member)

G. L. Nelson, senior agricultural engineer, farm bureau, Portland Cement Assn., 33 W. Grand Ave., Chicago 10, Ill. (Junior Member to Member)

R. A. Parmele, manager, Agonair Service, R. R. No. 1., Davenport, Iowa. (Junior Member to Member)

Charles H. Reed, lecturer in agricultural engineering, college of agriculture, Rutgers University, New Brunswick, N. J. (Associate to Member)

E. C. Schneider, chairman, agricultural engineering dept., University of Vermont, Burlington, Vt. (Associate to Member)

G. C. Vaughan, research engineer, The John Deere Tractor Co. (Mail) 161 Prospect Blvd., Waterloo, Iowa. (Junior Member to Member)

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration or license as a professional engineer.

NOTE: In this Bulletin the following listings still current and previously reported are not repeated in detail. For further information see the issue of AGRICULTURAL ENGINEERING indicated.

Attention is invited to the desirability of checking on the housing situation when considering a new location.

POSITIONS OPEN: MAY—O-499, 503. JUNE—O-506. AUGUST—O-510, 511. SEPTEMBER—O-516, 520, 521. NOVEMBER—O-523. DECEMBER—O-526, 527, 531, 532, 533, 534. JANUARY—O-535, 536.

POSITIONS WANTED: FEBRUARY—W-207, 254. APRIL—W-232, 237, 240, 276, 292. MAY—W-309, 312. JUNE—W-316, 320, 322. SEPTEMBER—W-337, 341. NOVEMBER—W-355, 356, 358, 359. DECEMBER—W-361, 363, 364, 365, 366, 367. JANUARY—W-368, 369, 370.

POSITIONS OPEN

AGRICULTURAL ENGINEER (instructor rank) for teaching courses in farm power, farm machinery, terracing, and soil conservation, in a southwestern land grant college. BS deg in agricultural engineering; MS deg desirable but not essential. Good health, initiative, dependability, reasonably good speaking ability and personality. Limited graduate study possible for man lacking MS deg. Nine month basis. Additional pay for summer work if services needed. \$2250. O-537.

RESEARCH FELLOW for research on new portable rotary drum type forage dehydrator, in combination with study for MS deg in agricultural engineering. Location Southwest. BS deg in agricultural engineering with above average scholastic record and farm background. Duration 12 to 16 months, depending on progress of work and individual requirements for MS deg. \$110 per mo max plus veteran's educational benefits or \$150 per mo max for non-veteran. O-538

RESEARCH FELLOW for work on machinization of cotton production, primarily chopping and harvesting, in combination with study for MS deg in agricultural engineering. Location Southwest. BS deg in agricultural engineering, with above average scholastic record and farm background. Duration 12 to 16 months, depending on progress of work and individual requiremetns for MS deg. \$62.50 per mo plus veteran's educational benefits. O-539

AGRICULTURAL ENGINEER (instructor rank) for teaching in agricultural engineering field, including electricity, water service, and irrigation in agricultural and technical institute in the East. BS deg in agricultural engineering, or higher, with demonstrated ability to teach, or promise of developing into a good teacher. Must be ambitious, willing and able to work, a good mixer, interested in teaching and young people. Eleven month basis. \$3400. O-540

IRRIGATION ENGINEER to manage new system for water association including 30,000 acres in California. Need not be graduate engineer but must have demonstrated equivalent mastery of irrigation engineering, and have practical experience in running an irrigation district. Requires ability to handle men and to take responsibility for operation of entire system. Use of new large house and car provided in addition to salary. Age, under 40. Salary, up to \$6000 for fully qualified man. O-541

AGRICULTURAL ENGINEER (research professor) for work in eastern agricultural experiment station. Perfection and application of farm equipment to be emphasized. Work will involve cooperation with other departments in many cases. MS deg in agricultural engineering or equivalent. Capacity to recognize problems and initiate needed research, with personality favorable to effective cooperative relationships. Institution is planning expansion in engineering in general, including agricultural engineering. Annual increase in salary to maximum for position, and possibility of advancement to higher administrative position. Age 30-50. Salary \$4200 to start. O-542

POSITIONS WANTED

AGRICULTURAL ENGINEER desires development or research work in the power and machinery field, in private industry or public service. BS deg in agricultural engineering, North Carolina State College, 1942; MS deg in agricultural engineering, Iowa State College, expected March 1947. Major in power and machinery, minor in machine design. Farm background. Commissioned service in Naval Aviation. No physical defects. Available April 5. Married. Age 25. Salary \$3000. W-371

AGRICULTURAL ENGINEER desires development work in rural electrification field, in private industry; or development, research, sales, or service work in power and machinery field. BS deg in agricultural engineering, Texas A. & M. College, January 1947. Undergraduate experience, 6 months in cotton research. Army service. No physical defects. Available now. Single. Age 22. Salary \$2400. W-372

AGRICULTURAL ENGINEER desires sales, sales engineering, or sales promotion work. BS deg in engineering, University of Missouri, 1932; in agriculture, University of Arkansas, 1940. Experience in district engineering, farm planning, sales engineering, construction and six years commissioned service in field artillery, transportation, and ordnance. No physical defects. Available within 30 days or less. Married. Age 36. Salary open. W-373

AGRICULTURAL ENGINEER desires work in power and machinery or rural electrification field. BS deg in agricultural engineering, Virginia Polytechnic Institute, expected March 1947. Farm background. Army enlisted and commissioned war service. No physical defects. Available April 1. Single. Age 25. Salary open. W-374